

NJD981134893

ROLLINS ENV SERV-FS PA INC
ADEP BLDG BALTIMORE PIKE
CHADSFORD, PA 19317



State of New Jersey
Department of Environmental Protection and Energy
Enforcement

Northern Bureau of Water And Hazardous Waste Enforcement
1259 Route 46 - Building 2
Parsippany, N.J. 07054

Scott A. Weiner
Commissioner

Diane K. Weeks
Assistant Commissioner

April 9, 1993

Dear Generator:

The New Jersey Department of Environmental Protection and Energy has reviewed its data base listing the amount of hazardous waste manifested off site by regulated generators. Our review indicates that your facility may fall into one of the following categories:

Small Quantity Generator

One time clean up of a hazardous waste discharge

If your facility does not generate hazardous waste and you wish to deactivate your EPA identification number, prefixed by the letters NJD or NJT, please contact the Bureau of Advisement & Manifest at the address listed below:

New Jersey Department of Environmental Protection & Energy
Division of Hazardous Waste Regulation
Bureau of Advisement & Manifest
401 East State Street, CN 028
Trenton, N.J. 08625

If your facility does generate hazardous waste, **but never** in quantities greater than 100 kilograms (220 pounds) of listed or characteristic waste, or 1 kilogram (2.2 pounds) of acutely hazardous waste, or 1001 gallons of waste oil **in any one month**, you may wish to deactivate your fully regulated generator (NJD) number and replace it with a small quantity generator (NJX) number. Applications for the (NJX) number can be obtained by calling Ms. Becky Bonfonti at (609) 292-7081.

Should you decide to retain your fully regulated generator number, your company will be subject to inspections and fees pursuant to N.J.A.C. 7:26-4A.

Should you have any questions concerning this matter, please call Mr. Dave Shotwell, Section Chief, at (201) 299-7592.

Sincerely,

Joseph M. Mikulka, Chief
Northern Bureau of Water and
Hazardous Waste Enforcement

Please Respond To:

Tel. #

7/19/94 NC L/R - L N - 1

JOEL

Jan

Smv

ROLLINS

ENVIRONMENTAL SERVICES (SALES) INC.

P.O. Box 337, Bridgeport, NJ 08014, 609/467-3105, FAX 609/467-1040

JUL 02 1991

AWCB

Copy to ED

AIR & WASTE
MGT. DIV.

91 MAY -8 PM 3:52

USEPA, REGION II

NJD 981134293

April 29, 1991

REGIONAL ADMINISTRATOR
U.S.E.P.A.
Region II
26 Federal Plaza
New York, NY 10278

RE: WASTE IMPORTATION NOTIFICATION

Gentlemen:

We are notifying you under N.J.A.C. 7:26-7.6 (c) 3 - "Facility Operators Responsibilities For Imports" of the New Jersey Hazardous Waste Regulations, that Rollins Environmental Services (NJ), Inc. regional incinerator at Bridgeport, New Jersey will receive waste from:

Rohm & Haas Canada, Inc.
Highway #2 East
Morrisburg, Ontario, Canada K0C1X0

Following is the waste name:

Spent Filter Aid, Zeolite, & Cation Exchange Resin

<u>Compound Name</u>	<u>Normal Concentration Range %W</u>
Polymethacrylates	20
Light Neutral Oil	20
Diatomaceous Earth	25
Zeolite (Alumina Silicates)	25
Cation Exchange Resin (acid form)	10

I certify under penalty of law that I have personally examined and am familiar with the information submitted in this document and all attachments, and that based on my inquiry of those individuals immediately responsible for obtaining the information, I believe that the information is true, accurate, and complete. I am aware that there are significant penalties for submitting false information, including the possibility of fine and imprisonment.

If you have any questions, please do not hesitate to contact me.

Sincerely,

Terry A. Harmeson

Terry A. Harmeson
President

/cr

May 1988

781134873
EPA-700/8-88-048

Hazardous Waste Ground-Water Task Force

Evaluation of Rollins Environmental Services Bridgeport, N.J.



United States Environmental Protection Agency

Let's protect our earth



Department of Environmental Protection

State of New Jersey

May 1988

Update of the Hazardous Waste Groundwater Task Force evaluation of Rollins Environmental Services (NJ), Inc., Bridgeport, New Jersey

The United States Environmental Protection Agency's Hazardous Waste Ground Water Task Force (HWGWTF) and the New Jersey Department of Environmental Protection NJDEP conducted an evaluation of the compliance of Rollins Environmental Services (NJ), Inc. (RES) with the interim status and ground water monitoring requirements of the Resource Conservation and Recovery Act (RCRA) as adopted by New Jersey. RES is one of the 59 commercial and non-commercial hazardous waste treatment, storage and disposal facilities to be evaluated. The on-site inspection was conducted over an eleven-day period from February 9 to February 19, 1987.

In the 1970s, various hazardous constituents were released to the soil, ground, and surface water due to spills and the operation of unlined surface impoundments. These releases resulted in NJDEP's issuance of an Administrative Consent Order (ACO) to RES in 1981. The ACO required sitewide ground water monitoring and decontamination procedures. Many of the surface impoundments were closed under this Order. Only 8 unlined storage surface impoundments (L-series lagoons) and 2 concrete lined treatment surface impoundments (basins B-206 and B-207) remain.

The Task Force conducted an in-depth on-site investigation of RES. The evaluation focused on (1) determining if the facility was in compliance with applicable regulatory requirements and policy, (2) determining if hazardous constituents were present in the ground water, (3) providing information to assist EPA in determining if the facility meets the EPA requirements for facilities receiving waste from response actions conducted under the Comprehensive Environmental Response Compensation and Liability Act (CERCLA).

The site evaluation conducted in February 1987 revealed violations of RCRA and New Jersey hazardous waste regulations. In summary, these included an inadequate ground water monitoring assessment program to meet compliance with RCRA and New Jersey regulations, inadequacies in RES' interim status ground water sampling and analysis procedures, deficiencies in on-site laboratories and violations of waste management practices and records maintained at RES.

Although RES has been following the 1981 State ACO, based on the Task Force findings the following actions will be required by RES:

1. RES must upgrade its existing site-wide ground water monitoring system to accurately assess on-and off-site soil, ground and surface water contamination. RES must expand its sampling of the horizontal and vertical extent of ground water contamination. In particular the north marsh area, the south marsh area, and the shallow artesian zone throughout the site require more sampling,

2. Revise the current ground water sampling and analysis plan to address the deficient procedures, methods and quality analysis/ quality control programs as outlined in the Task Force Report, and
3. Address deficiencies found in current waste management practices and records maintained at the facility.

On August 21, 1987, EPA and RES entered into a 3008(h) Administrative Consent Order. This Consent Order requires RES to correct the deficiencies found in the ground water assessment program and ground water sampling and analysis plans (items 1 and 2). Pursuant to the Consent Order, RES submitted a draft workplan in December 1987 to conduct a site-wide RCRA Facility Investigation (RFI). The workplan when approved by EPA and NJDEP will require the facility to accurately assess on- and off-site soil, ground, and surface water contamination. The Consent Order also requires RES to conduct Corrective Measure studies and to implement Corrective Measures based on the findings of the RFI. RES violations pertaining to waste management practices and record keeping (item 3) detailed in the Task Force Report have been corrected. The State issued the Notice of Violation (NOV) to RES on May 28, 1987. The facility came into compliance on June 28, 1987. Based on the latest EPA off-site policy and the entering into the 3008(h) Consent Order, EPA determined that RES is eligible to receive waste from response actions taken under CERCLA.

RES submitted closure/post-closure plans for the 8 unlined surface impoundments and 2 concrete lined treatment surface impoundments (B-206 and B-207) on May 15, 1986. RES is required to cease introducing waste into these units on or before November 8, 1988 and replace the surface impoundments with above ground tanks. On February 25, 1988 NJDEP issued RES a technical Notice of Deficiency (NOD) for its closure and post-closure plans. Following RES' response to the NOD, NJDEP issued RES a draft closure plan modification and approval for the 10 surface impoundments in the form of a NJPDES/DSW draft permit. On March 30, 1988, NJDEP public noticed this draft closure approval.

EPA and NJDEP public noticed a RCRA permit on May 23, 1988. The RCRA permit contains NJDEP's RCRA operating permit and EPA's permit pursuant to the Hazardous and Solid Waste Amendments of 1984 (HSWA). NJDEP's RCRA operating permit contains operating conditions for the incinerator, tanks and container storage areas, while EPA's HSWA permit incorporates the August 21, 1987, 3008(h) Consent Order.

ACKNOWLEDGEMENTS

It is a pleasure to acknowledge the particular assistance of my co-worker Jeffrey Gratz, who contributed immensely in evaluating RES' ground water monitoring program. In addition, I would like to acknowledge the assistance of the following personnel who provided information and technical guidance: Al Neshiewat, Tom Solecki, Joe Cosentino, Lou DiGuardia, Fred Haber, Brian Lewis, Carol Casazza, Thomas O'Keeffe, Tracy Wagner, Jack Allen, and Dave Zervas. Lastly, I wish to thank the personnel of Rollins Environmental Services (NJ) on behalf of the Task Force team for assisting us during the inspection, from February 9 to 19, 1987.

Samuel I. Ezekwo
Project Coordinator
U.S. Environmental Protection Agency
Region II

For further information regarding this report please contact:

Hazardous Waste Compliance Branch
U.S. Environmental Protection Agency
Region II
26 Federal Plaza
New York, New York 10278

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
HAZARDOUS WASTE GROUND WATER TASK FORCE

GROUND WATER MONITORING EVALUATION

Rollins Environmental Services (NJ), Inc.
Bridgeport, New Jersey

May 1988

Samuel I. Ezekwo
Project Coordinator
U.S. Environmental Protection Agency
Region II

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I. Executive Summary

A. Introduction

In 1965 Congress passed the Solid Waste Disposal Act, the first federal law to require safeguards and encourage environmentally sound methods for disposal of household, municipal, commercial and industrial refuse. Congress amended this law in 1970 by passing the Resource Recovery Act and again in 1976 by passing the Resource Conservation and Recovery Act (RCRA). As the knowledge about the health and environmental impacts of waste disposal increased, Congress revised RCRA, first in 1980 and again in 1984.

RCRA, including its 1984 amendments, is divided up into subtitles. Subtitles C, D, and I set forth the framework for EPA's comprehensive waste management programs: hazardous waste management, solid waste management and toxic waste and petroleum products stored in underground tanks. Parts 260 through 262, Part 263, Parts 264 and 265 of 40 CFR set requirements for the generation, transportation, storage or disposal of hazardous wastes respectively. The regulations for treatment, storage and disposal facilities (TSDF) are divided into two sets, one for interim status and the other for permitted TSDF's. The interim status regulations are found in 40 CFR Part 265, while the permit regulations are found in 40 CFR Part 264.

Section 3006 of Subtitle C of RCRA allows the EPA to authorize the State hazardous waste program to operate in the State in lieu of the Federal Hazardous Waste Program. The State of New Jersey received final authorization on February 21, 1985. This authorization does not include program elements under HSWA.

EPA has recognized that although the basic ground water monitoring requirements have been in existence since 1980, some of the commercial TSDFs have not achieved compliance. Adequate monitoring of the waste management units is important in order to determine whether the existing units are releasing hazardous contaminants into the ground water. Accordingly, the Administrator established a Task Force to evaluate the compliance status and determine the causes of poor compliance. The Task Force was charged to conduct in-depth onsite investigations of commercial TSDFs with the following objectives.

- ° Determine compliance with interim status ground water monitoring requirements of 40 CFR Part 265 as promulgated under RCRA or the State equivalent (where the State has received RCRA authorization)
- ° Evaluate the ground water monitoring program described in the facility's RCRA Part B permit application for compliance with 40 CFR Part 270.14(c)
- ° Determine if the ground water at the facility contains hazardous waste constituents

- ° Provide information to assist the Agency in determining if the TSDF meets the EPA ground water monitoring requirements for waste management facilities receiving waste from response actions conducted under the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), Public Law 91-510
- ° Identify significant ground water management, technical and compliance problems, and take enforcement or other administrative actions to correct the problems

To address these objectives, each Task Force investigation will determine if:

- ° The facility has developed and is following an adequate ground water sampling and analysis plan;
- ° Designated RCRA and/or State-required monitoring wells are properly located and constructed;
- ° Required analyses have been conducted on samples from the designated RCRA monitoring wells; and
- ° The ground water quality assessment program outline or plan as appropriate is adequate.

The TSDF investigated by the Task Force was Rollins Environmental Services (NJ) Inc. (RES) located along the eastern bank of Raccoon Creek in Bridgeport, New Jersey (Figure 1). RES' EPA identification number is NJD053288239. The facility has also operated under the name of Rollins Purle, Inc. The on-site inspection was conducted from February 9 through February 20, 1987, and was coordinated by staff of EPA Region II. In general, the investigation involved reviews of State, Federal and facility records, facility inspection, laboratory evaluation, and ground water sampling and analysis.

The 78-acre commercial treatment, storage and disposal facility has been in operation since 1969. RES accepts a wide range of hazardous wastes. Primarily, the wastes are received in gaseous, liquid and solid form; however, RES also stores sludges and slurries. Incineration is the only commercial operation at the facility. Incinerator ash, formerly landfilled on-site, is now transported elsewhere. Eight unlined surface impoundments receive scrubber wastewater from the incinerator for cooling and storage before discharge to Raccoon Creek. The facility also uses two concrete lined surface impoundments for biological treatment of contaminated ground water from 18 pumping wells on-site.

The facility notified EPA in November 1980 that it is conducting the following hazardous waste activities:

- ° Transportation of hazardous wastes;
- ° S01 - storage in containers;

- ° S04 - storage in surface impoundments;
- ° T01 - treatment in tanks;
- ° T02 - treatment in surface impoundments;
- ° T03 - incineration

RES certified Loss of Interim Status (LOIS) compliance with the applicable ground water monitoring requirements for the 10 regulated units at the facility in November 8, 1985.

Task Force Participants

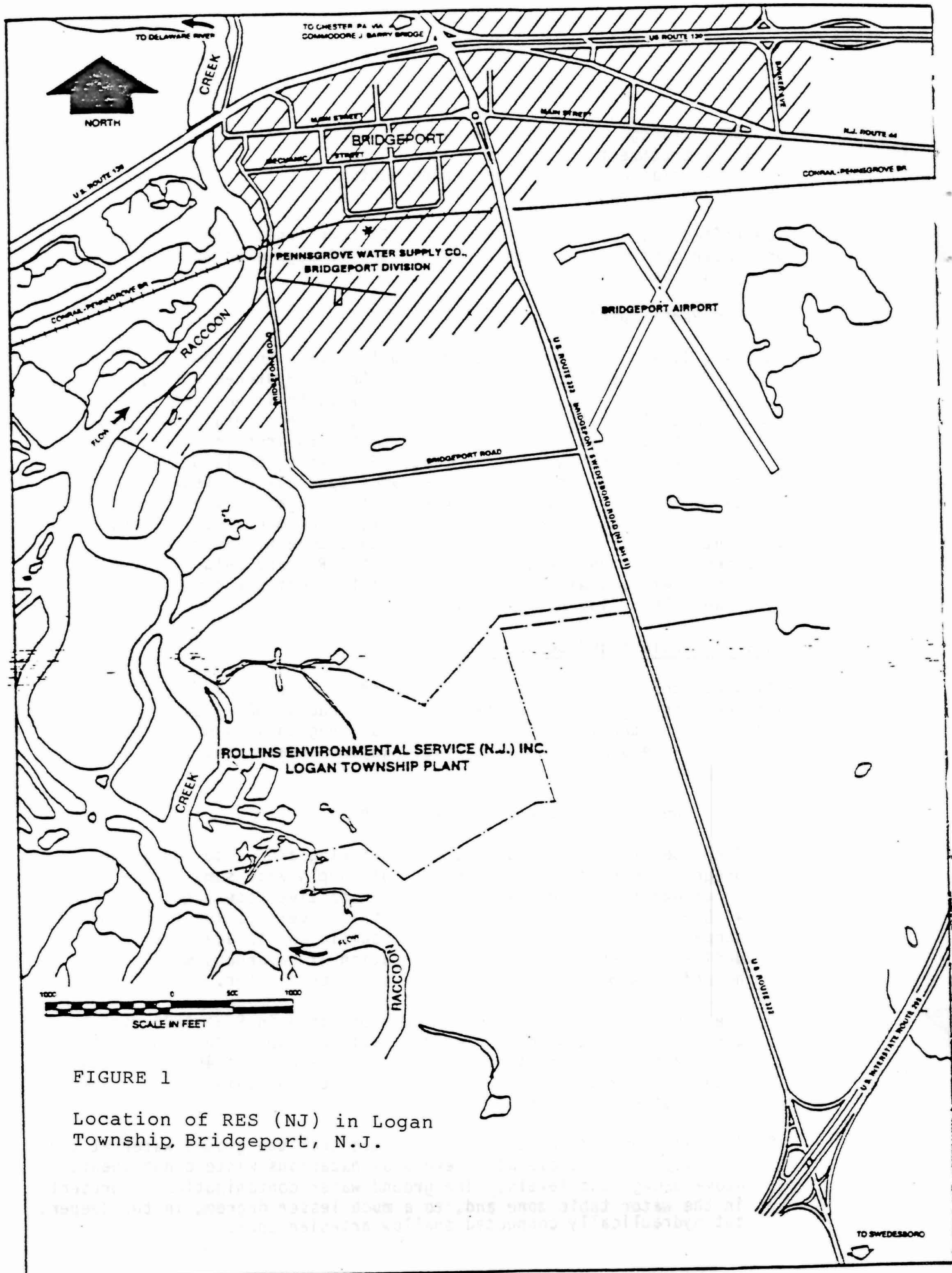
The USEPA - II Project Team included Samuel Ezekwo, Environmental Engineer, Hazardous Waste Compliance Branch; Jeffrey Gratz, Hydrogeologist, Hazardous Waste Compliance Branch; Ataliah Nesheiwat, Environmental Engineer, Hazardous Waste Facility Branch; Tom Solecki, Environmental Engineer, Hazardous Waste Compliance Branch; and from the Environmental Services Division, Joseph Cosentino, Environmental Scientist; Louis DiGuardia, Geologist; and Fred Haber, Quality Assurance Specialist. Representing the State of New Jersey for the Task Force investigation were Tracy Wagner, Hydrogeologist, Ground-Water Quality Management; Jack Allen, Environmental Specialist, Southern Region Enforcement. Representing EPA Headquarters was Brian Lewis, Hydrogeologist. Richard Deluca, David Billo, Mark Lewis and William Naughton were the contract sampling team from Alliance Technologies Corporation.

B. Summary of Findings and Conclusions

The findings and conclusions presented in this summary and report reflect conditions existing at the RES facility in February 1987. Subsequent actions taken by the facility, the State, and Region II since the investigation are summarized in the accompanying update memorandum attached to this report.

In summary, the Task Force has determined that:

- ° The interim status ground water monitoring and waste management programs were inadequate and did not comply with some of the requirements of the New Jersey Administrative Code (equivalent to 40 CFR, Part 265). In particular, this investigation finds the scope of RES' assessment program insufficient to adequately define the rate and extent of migration of hazardous waste or hazardous waste constituents into the ground water.
- ° The ground water monitoring program proposed in RES' 1985 Part B permit application and subsequent revisions up to the time of the inspection were deficient with the requirements of 40 CFR 270.14(c) (specifically with respect to ground water contamination assessment) and require modification.
- ° The Task Force investigation confirmed that the ground water at the facility contains elevated levels of hazardous waste constituents above background levels. The ground water contamination is present in the water table zone and, to a much lesser degree, in the deeper, but hydraulically connected shallow artesian zone.



- ° Prior to the time of investigation, the facility was considered unacceptable to receive hazardous waste from response actions conducted under CERCLA owing to (1) known releases of hazardous waste constituents into the environment and (2) non-compliance with applicable ground water monitoring regulations. The findings of the Task Force investigation confirm RES' unacceptability in receiving hazardous waste from CERCLA response actions.
- ° RES certified LOIS compliance with the interim status ground water monitoring regulations in 1985 and was not considered in significant non-compliance before the investigation. RES has followed the 1981 State ACO and, as a result, has installed numerous monitoring wells at various depths throughout the site. However, the Task Force evaluation noted a number of violations of interim status standards which included deficiencies in waste management practices and ground water Sampling and Analysis Plan requirements. The following is a more detailed discussion of investigation findings and conclusions.

1. Ground Water Monitoring During Interim Status

RES documented ground water contamination beneath its facility soon after operations began in 1969. The first ground water assessment study was submitted in early 1972, and by the end of the same year, RES had installed 25 wells, 6 of which were part of a pumping system. The purpose of the pumping system was to intercept, pump, and decontaminate the underlying ground water. RES continuously upgraded this abatement system through agreements with EPA and NJDEP, a signed 1981 Consent Order with NJDEP, and an unsigned 1983 Consent Order with NJDEP. RES' monitoring system remains essentially unchanged since 1983 except for the addition of several wells pursuant to a NJDEP request and RCRA requirements. Currently, RES samples regularly from approximately 55 monitoring wells. The facility's abatement system utilizes 17 pumping wells intermittently which pump an average of 125,000 gallons per day of contaminated ground water.

In the late 1970s, as a result of plant modifications and pressure from the regulatory community, RES began to scale down its operations and close many of its hazardous waste management units. The only remaining operational sources of contamination are RCRA units. These include the 8 unlined L-series lagoons and concrete-lined treatment units, Basins B-206 and B207. While RES acknowledges that the L-series lagoons leak contaminants into the ground water, it contends that the other two RCRA units which are concrete-lined, adequately contain wastes. However, because these units treat the same contaminated ground water which underlies them, a detection monitoring program can not detect a release of hazardous waste or hazardous waste constituents from these units. All 10 RCRA units, therefore, are in an assessment monitoring program which is part of a larger site-wide assessment/corrective action program pursuant to a 1981 State ACO. It should be noted that the RCRA land disposal units will cease accepting waste prior to November, 1988.

While RES has been following the 1981 State ACO (and later updated their program in accordance with an unsigned 1983 ACO), this investigation finds the scope of RES' assessment program insufficient to adequately define the rate and extent of migration of hazardous waste or hazardous waste constituents or their concentrations in the ground water as required under 40 CFR §265.93 (d)(4). While the facility has installed numerous monitoring wells at various depths throughout the site, several deficiencies in the system cause it to be inadequate to fully delineate the contaminant plume(s). For example, monitoring wells have been installed at RES for the past 18 years yet are highly variable in quality. Construction details for many wells are incomplete or non-existent. Some of the wells in the South Marsh Area were driven as well points and were not meant to be used for rigorous ground water monitoring. Poor well installation (inadequate annular seals) in some of the MA-series wells may, in fact, be a contributing factor to deep ground water contamination in the North Marsh Area. Also, the sampling parameters which RES uses to define the contaminant plume (although specified in the 1981 State ACO) are insufficient to delineate the extent of ground water contamination, particularly with respect to organic constituents.

This Task Force recommends that RES significantly expand its sampling and analysis plan to include specific organic constituents. The horizontal and vertical extent of contamination must be determined by using both organic and inorganic parameters. Specific areas which require more rigorous sampling include the North Marsh Area, the South Marsh Area, and the shallow artesian zone (a deeper water-bearing zone) throughout the site. Wells of poor construction quality should be sealed and data collected from them be used in this context. A future change to the plant site includes the closure of the L-series lagoons which is to be initiated at the end of 1988. Because their closure will affect ground water flow in the area (the L-series lagoons have acted as a ground water mound), this change should be modeled now so that the abatement system can be modified as lagoon closure occurs. While the pump and treat abatement system has been a very positive element in RES' site-wide corrective action program, it may also require modification once the full extent of ground water contamination has been determined. Finally, all previous data, which include a wealth of well logs, well tests, and ground water analyses, should be fully integrated with future work so that a clearer picture of hydrogeology and ground water/soil contamination and, consequently, a more efficient and effective corrective action program at RES can be developed.

2. Ground Water Sampling and Analysis Plan

Deficiencies were found in RES' sampling and analysis plan dated January, 1987. These deficiencies vary from initial safety considerations at the wellhead to inadequate analytical methods for TOX. The plan lacks sufficient detail in explaining the methods used to detect immiscible contaminants

and ensuring well integrity (measurement of total depth to monitor silting). Deficiencies are noted in other areas of the plan such as purge methods, field measurements, recordkeeping, sampling, chain-of-custody, well construction, and analytical methods. Adequate cleaning procedures for sampling equipment must be outlined and the use of trip blanks needs to be detailed.

3. Audit of Currently Used Laboratories

The evaluation of the analytical work of the laboratories being used by RES at the time of this investigation is included in the technical report. Inadequacies were found in the following areas:

- a. RES' procedures for determining TOX levels is inappropriate. The methods being applied can miss certain groups of halogenated compounds and lack sensitivity of the method EPA considers as appropriate for TOX measurement (Method 9020 of SW-846).
- b. RES uses an arbitrarily chosen detection limit of 1 mg/l for TOX and does not report amounts measured that are under 1 mg/l. Such practice does not allow the data user to identify or measure changes that occur when total levels present are less than 1 mg/l.
- c. The level of quality assurance and quality control practiced in their TOX determinations does not provide adequate confidence in the reliability of the data for the compounds that are determined by the RES procedure.

4. Well Sampling Data Analysis

Data generated as a result of ground water sampling by the Task Force confirm ground water contamination beneath the RCRA-regulated L-series lagoons and much of the rest of the 78-acre facility. Ground water from 23 monitoring wells was analyzed for Appendix IX constituents. The highest levels of contamination were found at wells around the L-series lagoons, the Central Plant Area and in the vicinity of Well MA-1 in the North Marsh Area. Contamination is not limited to the upper reaches of the water table zone; the deeper wells in the North Marsh Area showed contamination (particularly organics) as well. Of the three "shallow artesian zone" wells sampled in the deepest water-bearing zone at RES, only 1 showed any significant levels of contamination.

Monitoring wells around the L-series lagoons showed ground water with the highest concentrations of dissolved solids. For instance, the highest concentrations of the cations calcium (515 ppm) and magnesium (299 ppm) were found at Well 25, near the northwest corner of the L-series lagoons. Sodium

concentrations were very high in both the L-series lagoon area (738 ppm - Well 25) and in isolated spots in the North Marsh Area (1,570 ppm - Well MA-2D). The same is true of potassium (19.7 ppm - Well 25, 54.4 ppm - Well MA-2D). Total and dissolved metals were high along the periphery of the L-series lagoons and at nested wells MA-1 and MA-2 in the North Marsh Area. The highest nickel (150 ppm) and vanadium (.311 ppm) concentrations were found in MA-2D. Barium (.121 ppm), iron (151 ppm) and manganese (2.44 ppm) concentrations were highest in MA-1S.

While inorganic contamination is widespread at the site, organic concentration is predominant in the North Marsh Area (near MA-1 and MA-2) and in the Central Plant Area (Well 17). For example MA-1S contained the ground water with the highest concentrations of benzene (3,100 ug/l), 4-chloraniline (27,000 ug/l), toluene (1000 ug/l), naphthalene (1,000 ug/l) and other organics. Well 29 was contaminated with some of the following organic constituents: trichloroethene (230 ug/l), 2,4 dichlorophenol (170 ug/l), and bis(2-chloroethyl) ether (200 ug/l). Shallow artesian zone Well DP-5 was contaminated with 1,2-Dichloropropane (180 ug/l) and trichloroethene (20 ug/l). Low levels of furans were found in MW4 (HpCDF - 20.1 ppt). Many organic compounds were tentatively identified and need to be confirmed by using authentic standards for those specific compounds.

The ground water analytic results confirmed the presence of organic and inorganic contamination in the ground water beneath the RES site. The RCRA regulated L-series lagoons as well as various solid waste management units (SWMUs) and hazardous waste spills on the site have probably contributed to the degradation of the ground water.

5. Comprehensive Evaluation Inspection

Observations of waste management procedures and a review of records maintained at RES identified several Class I and Class II violations. These include: labels not visible on a small number of drums on both pad #1 and pad #2; no waste analysis plan for outgoing wastes; inspection schedule does not identify all areas/items to be investigated during the inspection (Kiln ash area, sumps and storage areas where hazardous waste is stored for less than 90 days); inadequate aisle space for four containers on drum pad #1; no written agreements designating primary emergency authority to a specific police or fire department; no agreements with others to provide support to the primary emergency authorities; no agreements with local fire departments to inspect the facility on a regular basis with at least two inspections annually; contingency plan did not list addresses and phone numbers (home) of all persons qualified to act as emergency coordinators to include primary and secondary; and the closure plan did not adequately include decontamination procedures during closure for drum pad #2 and Kiln ash storage area. Inspection of surface impoundments did not include inspection for the leaks, deterioration or failure in the impoundments.

II. Technical Report

A. Regulatory Requirements

In 1965, the Solid Waste Disposal Act was passed with the primary purpose of improving solid waste disposal methods. It was amended in 1970 by the Resource Recovery Act, again in 1976 by the Resource Conservation and Recovery Act (RCRA).

RCRA was enacted by PL 94-580, October 21, 1976; 90, 42 U.S.C. 6901 et. seq.; amended by PL 95-609, November 8, 1978; PL 96-463, October 15, 1980; PL-96482, October 21, 1980; PL96-510, December 11, 1980; PL 97-272, September 30, 1982; PL-98-45, July 12, 1983; PL 98-371, July 18, 1984; PL98-616, and November 8, 1984.

The Resource Conservation and Recovery Act is currently divided into nine Subtitles, A through I. Subtitles C, D and I lay out the framework for the three programs that make up RCRA.

Subtitle C of the Act establishes a program to manage hazardous waste from cradle to grave. The objective of this program is to assure that hazardous waste is handled in a manner that protects human health and the environment. The regulations are found in the Code of Federal Regulations (CFR), Title 40, Chapter I, Subchapter I, Parts 264, 265 and 270. As a result of the Hazardous & Solid Waste Admendments of 1984 (HSWA), new standard for treatment and disposal of restricted waste became effective on November 8, 1986. These regulation are found in 40 CFR Part 268.

Section 3006 of Subtlitle C of RCRA allows EPA to authorize a State hazardous waste program to operate in a State in lieu of the Federal Hazardous Waste Program. Under this section, States could either apply for interim or final authorization. Interim authorization is received in two phases: Phase I and Phase II. Upon the State implementing a program "substantially equivalent" to the RCRA program the State can apply for final authorization, a program equivalent to, and no less stringent than the Federal Program.

The State of New Jersey received Phase I interim authorization on February 2, 1983. Phase I allowed them to operate the regulations covering 40 CFR Parts 260 through 263, and 265. Phase IIA and IIB interim authorizations were granted to New Jersey on April 6, 1984. However, since New Jersey's application for Phase IIA and Phase IIB interim authorization was submitted after the deadline for inclusion of surface impoundments (January 26, 1983), their interim authorization only included the responsibility for permitting storage and treatment in tanks, containers, and incinerators. Phase II usually covers 40 CFR Parts 124, 264, and 270.

New Jersey applied for permitting authority of land disposal facilities on August 3, 1984. Their revised and complete application for final authorization was submitted on August 20, 1984. EPA published its intent to grant final authorization effective on February 21, 1985. This authorization did not include authorization for the Hazardous & Solid Waste Amendments.

New Jersey's RCRA program is run primarily by Division of Waste Management. However, since ground-water protection is delegated to Division of Water Resources, they take primary responsibility for RCRA ground-water issues. New Jersey's program is more stringent than the Federal program in the following aspects:

- ° Waste oil is listed as a hazardous waste, consequently, more facilities are regulated;
- ° No exemptions are provided from the ground water monitoring program;
- ° No waivers are granted during the interim status.

1. New Jersey Department of Environmental Protection Responsibilities

NJDEP is responsible for permitting treatment, storage, and disposal (TSD) facilities within the State of New Jersey's borders as well as carrying out the other aspects of the RCRA program. NJDEP is also responsible for enforcement. Further, NJDEP must assist EPA in the implementation of the Hazardous and Solid Waste Amendments of 1984 (HSWA).

2. Environmental Protection Agency's Responsibilities

EPA provides the State of New Jersey with Federal funding. EPA regularly evaluates New Jersey's administration and enforcement of its hazardous waste program to ensure that the authorized program is being implemented consistent with RCRA. EPA also retains the right to conduct inspections and request information under Section 3007 of RCRA, and to enforce certain provisions of New Jersey State law. Currently, under Section 3006(g) of RCRA, 42 U.S.C. 6226(g), the new requirements and prohibitions imposed by HSWA take effect in authorized States. EPA must carry out these requirements until the States are authorized for HSWA. Therefore, EPA will administer HSWA in New Jersey until New Jersey applies for and receives authorization for HSWA. Therefore, EPA's direct responsibilities include:

- ° Waiver requests;
- ° Solid Waste Management Units (SWMU);
- ° Land Disposal Restriction; and
- ° Corrective Action

B. Investigation Methods and Procedures

The Hazardous Waste Ground Water Task Force Investigation of RES facility consisted of:

- ° Reviewing and evaluating records and documents from EPA Region II, New Jersey Department of Environmental Protection and RES (NJ);
- ° Conducting a Compliance Evaluation Inspection (i.e., visual inspection of waste management units, operation, manifests);
- ° Evaluating on-site and off-site analytical laboratories;
- ° Sampling and analyzing data from selected ground water monitoring wells.
- ° Conducting a Comprehensive Ground Water Monitoring Evaluation (CME).

1. Records/Documents Review

Records and documents from EPA Region II and the New Jersey Department of Environmental Protection offices compiled by an EPA contractor, were reviewed prior to and during the on-site inspection. On-site facility records were reviewed to verify and supplement information currently in Government file. Documents requiring further evaluation were copied by the Task Force during the inspection. Information regarding facility operation, construction details of waste management units and ground-water monitoring program were reviewed.

Specifically, records and documents that were reviewed included the ground water sampling and analysis plan (s), outline of the facility ground water sampling, monitoring well construction data and logs, site geologic report, site operation plans, facility permits, waste management unit design and operating records showing the general types, quantities and location of wastes disposal of at the facility.

Generally, records and documents were also reviewed to address compliance with administrative, non-technical and technical requirements of 40 CFR Part 265, Subparts B through R and the New Jersey Administrative Code 7:26-6,7,8,9 and 11 et seq.

2. Comprehensive Ground Water Monitoring Evaluation

This evaluation composed of an office and field evaluation. The emphasis was to determine compliance with the Federal and State of New Jersey interim status ground-water monitoring requirements (40 CFR Part 265 Subpart F and N.J.A.C. 7:14A - 6.1 et seq.). Compliance with the requirements of 40 CFR Part 264 Subpart F was also investigated.

All existing records and documents from NJDEP and EPA - Region II were compiled by a contractor working for EPA - Headquarters.

Each participating group (Region, State and Headquarters) reviewed the materials prior to the on-site inspection to generate information covering the following:

- ° Probable areas of noncompliance with 40 CFR Part 265 Subpart F requirements;
- ° Probable existence and nature of contamination of the ground water;
- ° Other shortcomings in monitoring system design and operation;
- ° Validity and comprehensiveness of existing data;
- ° Useful activities to be conducted during the site inspection;
- ° Effectiveness of corrective action or closure operations.

Several meetings were held between EPA-Region II and NJDEP to discuss the site and choose sampling locations for the inspection. Site reconnaissance was conducted to verify the practicality of the inspection strategy and familiarize the Task Force members with RES facility.

Twenty three of possible 130 wells were selected for sampling. One field/equipment blank was taken per day of the inspection.

The "Characterization of Site Hydrogeology Worksheet" from the draft version of the RCRA Ground Water Monitoring Technical Enforcement Guidance Document was used as a guideline for the office evaluation. The Worksheet questions were answered using the Part B and any supporting documents supplied by RES. Further, several interviews were conducted pertaining to hydrogeology and the ground water monitoring system. One of these interviews was conducted on Tuesday February 17, 1987 where RES was represented by their hydrogeological consultant, Geraghty & Miller, Inc.

3. Ground Water Sampling and Analysis

During the inspection, Task Force personnel collected samples for analysis from twenty three ground water monitoring wells to determine if the ground water contains hazardous waste constituents or other indications of contamination. Wells were selected for sampling principally in areas where records show or suggest that ground water quality was affected by hazardous waste management activities.

All wells were purged of at least three well casing volumes of water with either a teflon bailer, stainless steel bailer or a stainless steel submersible (grundfos sp-2). The grundfos pump used to purge three wells was field decontaminated between each use by operating the pump in a de-ionized water and non-phosphate soap solution, followed by operation in de-ionized water as a rinse. The outside of the pump and the first ten feet of cable

were then wiped down with hexane and allowed to dry. All other purging and sampling equipment was laboratory cleaned and prepared prior to use. Purge water was measured for pH, temperature, and conductivity at the beginning, middle and end of purging. All samples were collected with a teflon or stainless steel bailer.

Twelve field/equipment blanks were also taken during sampling at RES. Following the collection of the samples, EPA's contractor, Alliance, placed the samples in coolers containing ice. Samples were preserved, and if necessary, filtered upon return to the staging area. Packaging was conducted in accordance with applicable Department of Transportation regulations for shipment to the EPA contract laboratories. As required under RCRA (40 CFR 265.92(a)(4)), receipt for samples were offered to and signed by facility personnel. Samples were split with the facility.

4. Evaluation of On-site and Off-site Analytical Labs

The RES and contractor laboratories handling ground water samples were evaluated regarding their respective responsibilities under the RES ground water sampling and analysis plan. Analytical equipment and methods, quality assurance procedures and records were examined for adequacy. Laboratory records were inspected for completeness, accuracy and compliance with the State and Federal requirements. The ability of each laboratory to produce quality data for the required analysis was also evaluated.

5. Compliance Evaluation Inspection

The Compliance Evaluation Inspection conducted in February, 1987, included identifying past and present waste management units and reviewing waste management operations. The units were reviewed to address the technical requirements of 40 CFR 265 Subpart I-R and N.J.A.C. 7:26-9.11 et seq.

The inspection procedures to verify compliance with these Subparts included a series of checkpoints and documentation, and use of the New Jersey RCRA inspection checklist.

C. Facility Description

1. General Information

In 1970 Rollins-Purle, Inc. began operation of a waste disposal at Bridgeport, New Jersey. Following a number of reorganizations, the owner-operator is now known as Rollins Environmental Services (NJ) Inc., a New Jersey Corporation. Rollins Environmental Services (RES) with head offices in Wilmington, Delaware, is a publicly-held company with shares traded on the New York Stock Exchange.

Facility Address: Rollins Environmental Services (NJ)
Route 322 and Route 295
Bridgeport N.J. 08014

Mailing Address: Rollins Environmental Services (NJ)
P.O. Box 337
Bridgeport N.J. 08014

Telephone Number: (609) 467-3100

Facility Contact: Donald J. Frost
Technical Manager

Facility Owner: Rollins Environmental Services

Facility ID #: NJD 053 288 239

Type of Operation: Transportation, storage, treatment and
disposal of hazardous waste

2. Description of Facility Operations

A general description of the facility operations will be given here. A more detailed description of each waste management unit can be found in the RCRA inspection report.

RES is a 78-acre commercial treatment, storage and disposal facility located in Bridgeport, New Jersey. The facility has been in operation since 1969. RES' incinerator was built in 1969 and commenced operation in 1970. The facility accepts a wide range of hazardous waste: pesticides - DDT and Lindane; halogenated aliphatic hydrocarbons; monocyclic aromatics; phthalate esters; polycyclic aromatics; ketones; alcohols; and miscellaneous volatiles (acrolein, ethylether, and, acrylonitrile). Incineration is the only commercial operation at the facility. The biological treatment system is used for the treatment of wastes generated on site (contaminated ground water and sanitary wastes). Besides the biological treatment system impoundments (B-206, B-207), all other treatment units have been discontinued. RES (NJ) is the only commercial hazardous waste incinerator facility in Region II.

In December, 1985, the facility submitted a revised Part A application for the following processes:

<u>Unit</u>	<u>Capacity</u>
S01-storage in containers	121,550 gallons
S02-storage in tanks	406,000 gallons
S04-storage in surface impoundment	3,000,000 gallons
T01-treatment in tanks	6,813,300 gallons/day
T03-Incineration	19.7 tons/hr

Currently, RES operates the incinerator under interim status regulations. Wastes are incinerated in gaseous, liquid and solid form. Incinerator ash, formerly landfilled on-site, is now transported to secure hazardous waste landfills elsewhere. Eight interconnected unlined surface impoundments (called L-Series lagoons) receive scrubber wastewater from the incinerator for cooling. Two concrete lined biological treatment surface impoundments are used to treat contaminated ground water from 18 pumping wells on-site. All 10 units are RCRA regulated and discharge to Raccoon Creek under the terms of RES's NJPDES permit. RES plans to close all its RCRA surface impoundments. A closure/ post-closure plan was submitted for all process water discharge lagoons. Above ground tanks will be installed to replace the 10 storage and treatment surface impoundments.

3. Solid Waste Management Units (SWMUs)

Solid waste management units include any discernable waste management unit from which hazardous constituents may migrate, irrespective of whether the unit was intended for the management of solid or hazardous wastes. The following type of units are therefore included in the definition of SWMUs: landfills, surface impoundment, waste piles, land treatment units, incinerator, injection wells, tanks (including 90 days accumulations tanks), container storage areas and transfer stations. In addition to these types of units, certain areas associated with production processes at facilities which have become contaminated as a result of routine, systematic and deliberate releases of wastes, are also considered to be solid waste management units. A product may become a waste if it is abandoned or discarded.

The SWMUs identified by NJDEP and EPA at the site include:

<u># of Units</u>	<u>Descriptions</u>
11	Unlined lagoons closed as a landfill in 1978 (NJDEP approved closure)

<u># of Units</u>	<u>Description</u>
2	Cement vaults containing 3695 cubic yards of drummed arsenic salts.
15	Lined surface impoundments closed in 1978 (NJDEP approved closure)
21	Tanks to store various aliphatic aromatic, including PCBs. Destroyed by fire in 1977
1	Trickling filter unit, used to treat contaminated ground water, closed in 1979
2	Container storage pads, in operation from 1973-1978

D. Ground Water Monitoring Program During Interim Status

1. RES Compliance History

a. Early Plant History - 1970s

Rollins Environmental Services (RES) was constructed in 1969 as a disposal site (Figure 2) for a wide range of industrial process wastes. Several processes employed at the site, which included incineration, biological and physical-chemical treatment and landfilling, were applied to the disposal of various classes of wastes. Throughout the 1970s the facility incurred numerous operational problems and was subject to almost continuous modification. By 1971, approximately 18 basins of varying sizes and construction quality were developed on the site (Figure 3). Initially six of these basins were clay lined; these included receiving and neutralizing basins as well as the organic filter beds which were supposed to provide biological degradation of organic wastes.

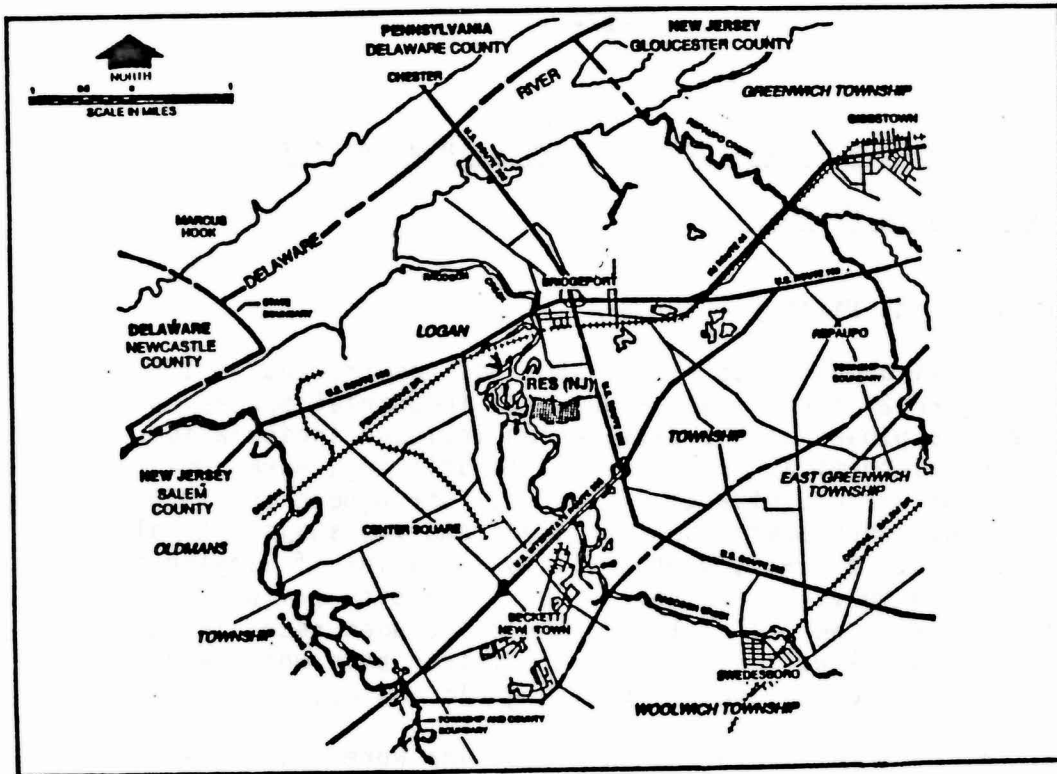
It became apparent in 1971 that the basins were leaking and causing contamination of the ground water. The first confirmed evidence of ground water contamination at RES was gathered in 1971. Analyses of samples from shallow monitoring wells at the site showed elevated levels of acidity, total dissolved solids, nitrates, and metals. The facility was ordered by the State to commence decontamination activities on October 20, 1971. In reports dated April, 1972 and October, 1972, RES' consultants, Geraghty and Miller, Inc., provided results of a ground water contamination study and submitted a proposed abatement program. By this time RES had installed approximately 25 wells, all of which were screened in the water table aquifer. Six of the wells were abatement wells for the purpose of intercepting, containing, pumping and decontaminating ground water. This abatement program, the details of which are sketchy, presumably began shortly after a second State Order was issued on October 20, 1972. It was also agreed that RES would initiate a program to reline (with concrete, soil-cement and plastic) or eliminate the unlined basins at the facility.

The ground water remediation program continued through the 1970s. In 1975, deeper wells were installed to monitor the shallow artesian zone. Wells were continually added to the monitoring system. Evaluations were made on the abatement system in 1975 and 1978 by Geraghty and Miller, Inc. Based on their recommendations, the system was modified with the addition of more abatement wells. A more detailed discussion on the history of RES' ground water monitoring system will be presented in subsequent sections.

b. Events Surrounding the 1981 Administrative Consent Order

In December of 1977, a fire and explosion occurred in the tank farm area of the facility. Eighteen of thirty-one tanks were destroyed. Corrective

(a)



(b)

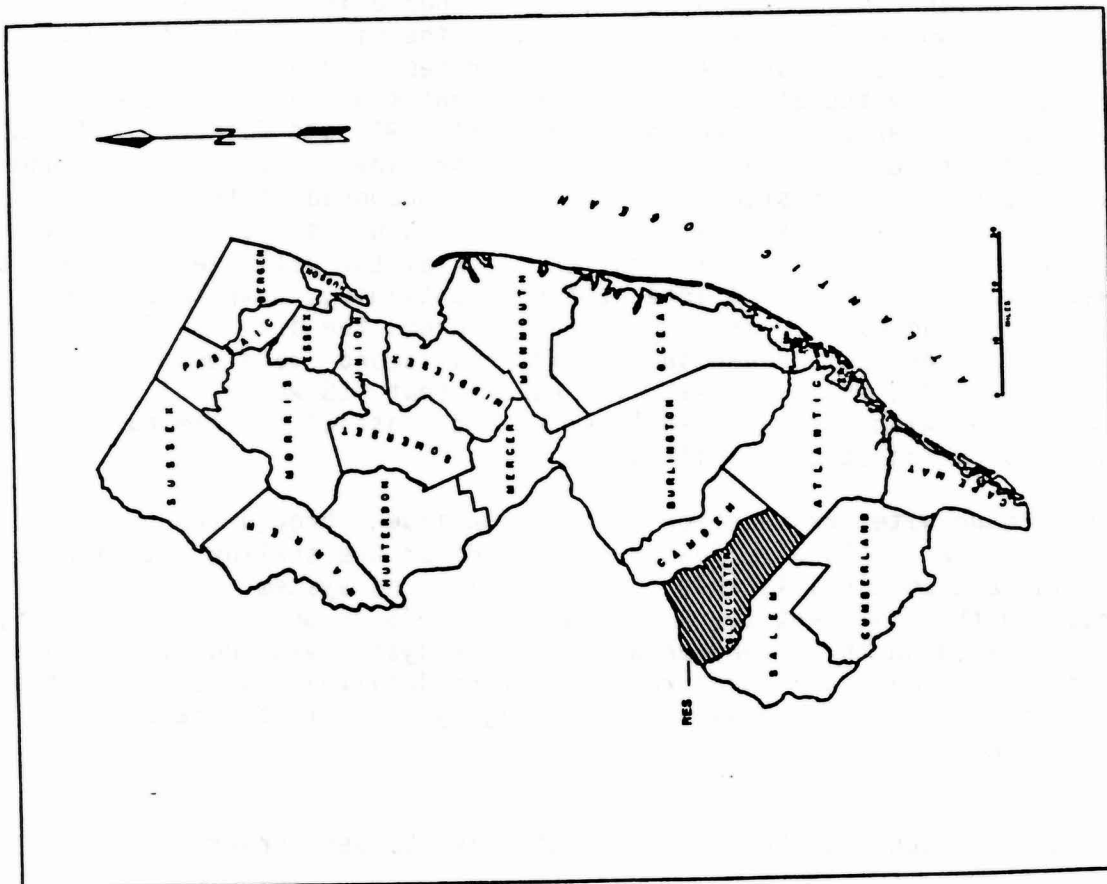
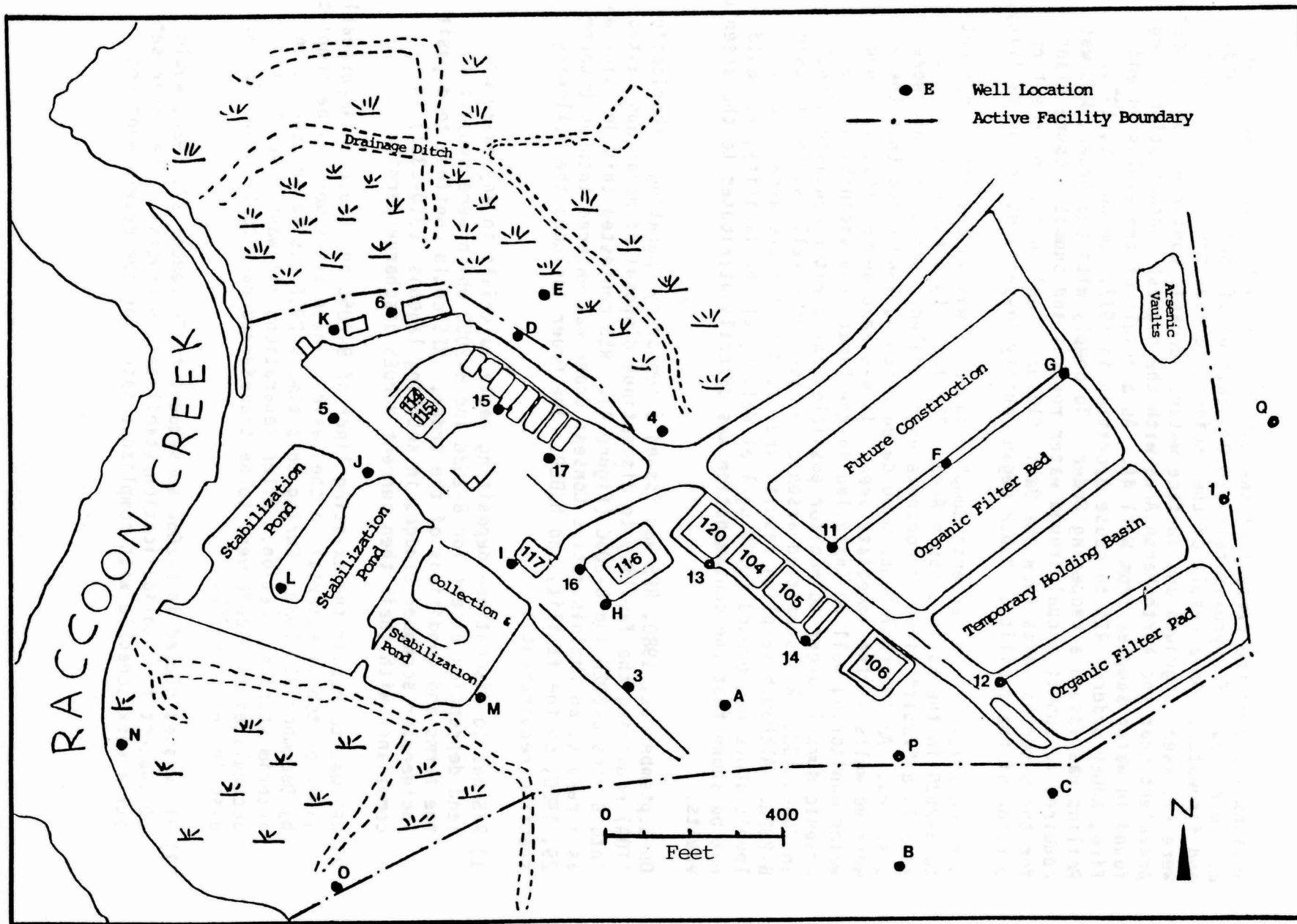


Figure 2. Location of RES (NJ) facility with respect to (a) the Delaware River and surrounding townships and (b) counties within the state of New Jersey. From RES (1985) and Hardt (1963).



Rollins Environmental Services Facility Map - 1972

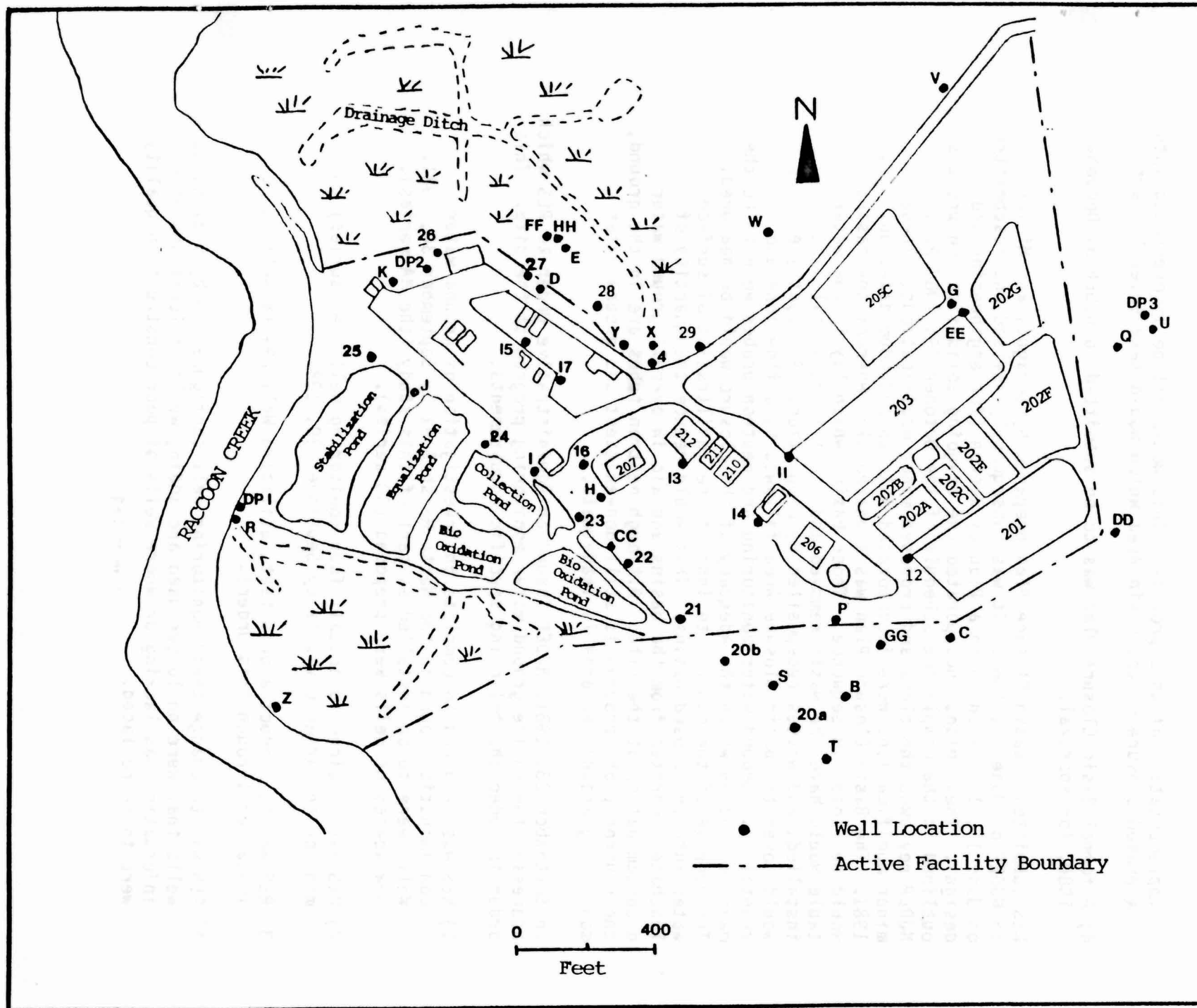
actions included the removal of the top foot of soil in the area as well as the removal of approximately 120,000 gallons of contaminated liquids and firewater. As a result of the incident various organic contaminants were released to ground and surface water. Organic contamination is most prevalent near the North Marsh Area with the highest contamination being found in water samples from Well 4A. As a result of the explosion and fire, NJDEP ordered RES to cease operation in 1977. On June 9, 1978, Rollins was issued a reopening Order. To comply with the Order, RES was required to submit annual ground water reports and submit closure plans for the B-series units (now the Basin Closure Area) in the northeastern portion of the facility. NJDEP began monthly Inspections at the facility.

Between 1970-1974 an "arsenic dump" (Figure 3) was in operation adjacent to B-202G in the Basin Closure Area. The facility contends that this area is a "vault" lined in concrete where sealed drums of arsenic were disposed. An internal NJDEP memo dated March 4, 1980 noted that there were no wells in the immediate area. It was recommended that a ground water monitoring well be installed in the "immediate vicinity of the arsenic dump in order to monitor possible ground water contamination." In June, 1980, RES submitted arsenic analyses from wells south of basin B-202G. Although sampling results indicated that there were arsenic levels above background (0.36 ug/l at Well G) at the facility, it could not be shown that the contamination was directly attributed to the arsenic vaults.

On September 22, 1980, RES was issued a Temporary Operating Authorization (TOA) requiring the facility to discontinue disposal of hazardous wastes into Basins B-202G and B-205C (Figure 4). RES contested this decision and, as a result, an Administrative Consent Order was entered into on October 29, 1980, by the facility and NJDEP. The Order included the following specific requirements:

- 1) RES was to discontinue depositing waste materials in any basin or land depression except for B-202G and B-205C which were subject to the terms and conditions of the Order. RES could continue to deposit incinerator scrubber sludges in settling lagoons (L310-L317) in compliance with their then current NJPDES discharge permit.
- 2) RES was to repair the existing liner of B-205C and place an impermeable liner on top of material in the basin. These tasks were to be completed by December 31, 1980. During this time B-202F was to be used as an interim storage location. After reparations all wastes which had accumulated in B-202F were to be transferred back to B-205C. RES was also to repair B-202G.
- 3) All wastes placed in B-205C subsequent to September 22, 1980, would be subject to a solidification/stabilization process. The Order set out a work schedule with compliance dates for the development and

Figure 4



Rollins Environmental Services Facility Map - 1980

implementation of this process. This would all be incorporated into a phased closure of the Basin Area which would take several years.

- 4) A formal Basin Closure Plan was to be submitted to NJDEP by December 1980, for approval.

RES submitted a Basin Closure Plan prepared by Geraghty and Miller to NJDEP on June 27, 1980. It was subsequently revised and resubmitted on June 12, 1981 along with a Plan by Weston (for engineering and design). These plans incorporated the on-going solidification process outlined in the compliance schedule of the October 29, 1980 ACO. NJDEP reviewed the plans and proposed minor modifications. These minor modifications were incorporated into an addendum dated July 22, 1981. The Basin Closure Plan was a phased plan whereby the basins would be closed in sequence. Those basins which lay in the water table would have the waste removed and stabilized, a soil base installed, and wastes redeposited by compaction. A polyethylene cap would cover the Basin Closure Area followed by a flow zone and vegetation. Ground water monitoring and neutron probes were to be the major method by which the adequacy of the closure would be measured. The purpose of the cap was to inhibit the infiltration of surface water into the closed basins. This would reduce the quantity of leachate generated from the basins and aid in overall ground water decontamination at the site. Although neutron tubes are in the ground, the neutron probe program is still non-existent and ground water monitoring around the area is inadequate.

On September 23, 1981, NJDEP issued an Administrative Order to RES which addressed the entire ground water monitoring program at the site. This order included the following specific requirements:

- 1) RES was required to complete an investigation of ground water contamination found in the North Marsh Area by September 30, 1981. Wells were to be installed as part of this study (the MA series). New abatement wells were proposed (30 series).
- 2) RES was required to install four monitoring wells (AV series) to monitor the arsenic vaults by September 30, 1981.
- 3) RES was to conduct a pump test, utilizing Well DP4 (a well to be installed through this Order).
- 4) RES was to change their monitoring well configuration by sealing some wells that were no longer used and adding wells in locations where information was lacking or where wells of poor construction quality were to be replaced.

- 5) RES was to plan and implement an abatement system such that the abatement wells yielded sufficient ground water to maintain a hydrologic barrier to prevent off-site migration of contaminants. The Order outlined some specific conditions of the planned system. The yield was not to be less than 15 gpm for any well and a pumping schedule was to be supplied. RES was to implement the system by March 1, 1982.
- 6) RES was required to sample specific wells for specific parameters. 28 wells were to be sampled quarterly for TDS, TOC, pH and TOX. 19 wells were to be sampled on an annual basis for an expanded list which included the above parameters along with these additional parameters: arsenic, cadmium, chromium (total), copper, lead, zinc, nitrate as nitrogen and phenol. 15 wells were to be sampled quarterly for arsenic and 4 wells quarterly for PCBs.
- 7) RES was to incorporate the new marsh wells into this monitoring program if contamination was found.
- 8) RES was to continue to submit annual ground water monitoring reports.
- 9) RES was to implement the Basin Closure Plan as described in the Geraghty and Miller Basin Closure Plan of June 12, 1981, the Westin Basin Closure Plan of June 12, 1981 and the addendum to the RES Basin Closure Plan of July 22, 1981. These plans would be implemented after approval by the Delaware River Basin Commission which reviewed the ground water aspects of the plan. RES was still responsible for submitting a specific monitoring plan for NJDEP approval.
- 10) RES was to implement a program to "Characterize Waste Through Ground Water Monitoring" by sampling 5 wells in the Basin Closure Area. RES was to submit this report by October 31, 1981.

On September 30, 1981 RES submitted a report, "Investigation of Ground Water Quality Conditions in the Marsh Area in the Northwest Corner of the Rollins Environmental Service Plant, Bridgeport, New Jersey." The report addressed the requirements of the above Administrative Order. Wells to monitor contamination near the arsenic vaults were also installed; however, two of the wells were not installed according to required specifications and had to be redrilled. RES installed Well DP4 on October 5th and 6th and conducted a well test on October 15th and 16th. On November 23, 1981, Rollins and NJDEP entered into an Administrative Consent Order. This order addressed some of the submittals of September 30, 1981 and also made some stricter requirements for sampling parameters. Otherwise it was similar to the previous AO. It included the following:

- 1) RES was required to replace monitoring wells AV-3 and AV-4 which were installed improperly around the arsenic vaults.

- 2) By November 6, 1981, RES was to submit the findings of the shallow artesian well test. The purpose of the well test was to determine the extent of hydraulic connection between the water table aquifer and the shallow artesian zone as well as aquifer characteristics of the shallow artesian zone.
- 3) RES was to sample 23 wells for the expanded list of parameters referred to in the previous Order. This included the deep wells which were previously only to be sampled for TDS, TOC, pH and TOX. Besides these changes most conditions of this Order were similar those of the Administrative order outlined above.

Subsequent to the Order, several revisions were made based on yearly ground water reports and the Abatement Well Testing Program Report of August, 1982. More abatement wells were added in 1982 and 1983 and pumpage rates were again revised. On August 1, 1983 a new draft Administrative Consent Order was circulated for comment. This Order was never finalized; however, RES contends that they presently follow the intent of the Order in good faith. By mid-1983 eleven additional abatement wells were added to the system. The efficiency of each well was evaluated and new pumping rates were determined. By June, 1983, RES was averaging a monthly pumping rate of 40 gallons per minute. Soon after the draft 1983 Order was issued, the pumping rate was increased to 100 gallons per minute.

On September 11, 1984, RES met with the State to again modify their ground water monitoring program. This modification, however, which included the deletion of some wells from the sampling program and the addition of others was not agreed upon and never followed. The monitoring/abatement system has not changed dramatically since 1983 when the system was upgraded. By 1983 all wells in the Basin Closure Area were removed because of closure operations. On October 16, 1983, NJDEP prepared an "Environmental Assessment" of RES. The original purpose of developing this extensive document was to address the issue of whether or not PCBs could safely be incinerated at the RES site. With time, however, the project expanded and became an in-depth study of all aspects of the environment (air, surface water, ground water) which could be affected by any past and present operations at the facility. The report concluded that while contamination existed in the water table aquifer (shallow aquifer) and minor contamination existed in the shallow artesian zone (deeper aquifer), the remediation efforts underway at the facility (expanded abatement system and Basin Closure) "should produce positive results in the future."

c. Part B Submittal and LOIS Certification

In March, 1985, RES submitted a RCRA Part B application which addressed ground water monitoring requirements at surface impoundments. RCRA regulated surface impoundments (units which accepted waste on or after

November 19, 1980) included the unlined L-series lagoons and biological treatment surface impoundments B-206 and B-207. On May 2, 1985, NJDEP informed RES that they did not have an adequate ground water detection monitoring program pursuant to 40 CFR 265.90 and N.J.A.C. 7:14A-6.3. Although NJDEP recognized there were many existing monitoring wells at the facility, RES was still required to implement a separate ground water detection monitoring program for the RCRA impoundments per N.J.A.C. 7:14A-6.3. RES was warned that if they did not comply with these requirements they would not be able to certify compliance by November 8, 1985 (the LOIS deadline) and their Interim Status would be terminated.

RES responded on May 17, 1985, by referring to the 1981 ACO. They described the specific requirements of that Order as an Alternative Monitoring Program which they felt complied with the NJDEP's request. RES, however, installed new wells around the B-206 and B-207 impoundments to satisfy one of the specific requests of NJDEP's May 2 letter.

On August 20, 1985, NJDEP issued a formal Notice of Deficiency (NOD) in response to RES' March, 1985, Part B application submittal. RES resubmitted the Part B application in December, 1985. On December 3, 1985 a LOIS (Loss of Interim Status) inspection took place at the facility. As a result of the inspection, RES was found to satisfy the minimum requirements of LOIS for both ground water monitoring and financial responsibility. It is important to note that, even though they passed the ground water inspection for minimum physical compliance (1 upgradient well, 3 downgradient wells), it was not an evaluation of the technical adequacy of the system. On April 17, 1986, NJDEP sent an NOD to the facility in response to RES' latest Part B submittal. The State found RES' application deficient with respect to ground water monitoring requirements. The State requested the submission of closure plans for the L-series lagoons and the biological treatment surface impoundments B-206 and B-207. The following is an outline of the specific ground water deficiencies and the request for information:

1) Interim Status ground water monitoring data:

- a request for information regarding statistical analyses
- a sampling and analysis plan

2) Topographic map

- a need to submit a topographic map which delineates the hazardous waste management area and points of compliance for the L-series lagoons and B-206 and B-207.

3) Plume description

- RES should provide a description of any plume of contamination entering the ground water. NJDEP deemed the total dissolved solids (TDS) contour which had historically outlined contamination to be inadequate.

4) Ground water monitoring program

- RES needs to implement an adequate detection monitoring program to determine whether B-206 and B-207 are leaking. The program has to take into consideration the types of hazardous material in the impoundments and their effects on liner materials.
- A corrective action program now being implemented is inadequate. RES must determine the rate and extent of contamination at the site. This includes an evaluation of each hazardous constituent (only indicator parameters were used in the past) found in the ground water.

RES responded to the NOD on May 15, 1986. Their submittal also included an Interim Status Facility Partial Closure and Post-Closure Plan for all RCRA surface impoundments. In their response, RES delineated 30 wells to be used as a part of a long-term assessment program. These wells would not monitor a specific RCRA unit, as RES contended several plumes at the site could not be differentiated; therefore, the system would consider the entire plume area. This new monitoring program was a significant revision from the program in the NJDEP 1981 Consent Order which required RES to monitor 45 wells. RES contended that the analytical suite would be expanded to make the new system a more efficient and effective one. RES argued that a statistical analysis was unnecessary as the facility was in a State Corrective Action Program and, although it argued that B-206 and B-207 were not leaking, the facility would treat these units as if they were (i.e., these units would be in Corrective Action as well).

With respect to NJDEP's request for information concerning site hydrology, RES referred the State to reports prepared as a result of a shallow artesian zone well test in October, 1981, water table zone well tests in July, 1982, and assorted well logs. RES sent a new topographic map delineating RCRA regulated units and points of compliance. In response to NJDEP's request for RES to identify the concentration of each of the hazardous constituents in the contaminant plume, RES developed a new analytical sampling suite for interim status wells. RES contended that, although they felt that they had adequately delineated the plume in accordance with the 1981 ACO, they would agree to "supplement this information."

At the time the response to the NOD was sent (May, 1986), RES was almost finished with closure of its Basin Closure Area. RES reviewed what had been done to date: closure of Category A (basins B-204, B-210, B-211, and the arsenic vault), Category B (basins B-202E, B-202F), and Category C (basins B-201, B-202A through D, B-202G, B-203). RES contended that all waste was stabilized using pozzolanic material and raised 2 feet above the maximum anticipated ground water elevation. A 60 mil polyethylene liner was placed over Category B and C basins. In May of 1986, RES was

placing a final cover of top soil and seed; closure was completed by the end of June, 1986. RES believes that closure of the L-series lagoons and B-206 and B-207, along with operation of the ground water abatement system, will "further enhance the improvement in ground water quality".

d. Situation at the Time of the Task Force Inspection

Presently, the biological treatment system (B-206, B-207) receives on-site generated sanitary wastes and ground water captured by the on-site abatement well system. After treatment this waste is fed into the L-series lagoons and discharged to Raccoon Creek under a NJPDES Permit after being combined with scrubber effluent in the cooling process. Closure plans are currently being reviewed for both the L-series lagoons and B-206 and B-207. Under Federal regulations these units cannot accept any waste after November 8, 1988. RES has submitted plans for above ground tanks to replace these units as well as plans to install storm water retention basins.

In May, 1985, the State issued a draft modification to the existing NJPDES discharge permit which included ground water monitoring. The draft permit went through the public comment stage but has not been sent to RES for finalization. There are some major differences between the State's monitoring plan and that supplied by RES in their NOD response. Currently, RES is following neither plan. The Facility is conducting a ground water program pursuant to the November 1981 ACO along with modifications made in 1983.

In November, 1985, RES added 8 wells to the monitoring system as to comply with the LOIS requirements. Although RES has been in compliance with the 1981 State ACO along with subsequent revisions, the facility has still not adequately addressed the rate and extent of contamination at the site pursuant to 40 CFR 265.93(d).

2. Regional Setting

a. Physiography

New Jersey may be divided into four physiographic provinces: Valley and Ridge, Appalachian Highlands, Piedmont, and the New Jersey Coastal Plain. Rollins Environmental Services lies within the New Jersey Coastal Plain, a province which encompasses 4,200 square miles and extends from Raritan Bay to the northeast to Delaware Bay to the southwest (Gill and Farlekas, 1984). It is bounded to the east by the Atlantic Ocean and to the west by the Fall Line, a geologic contact zone between the consolidated rocks of the Piedmont and Highlands and the unconsolidated sediments of the Coastal Plain (Figure 5). The New Jersey Coastal Plain is part of the larger Atlantic Coastal Plain that extends from Florida to Newfoundland and eastward to the edge of the Continental Shelf (Zapeczka, 1984).

Another physiographic feature is the drainage divide (Figure 6). Approximately 55% of the stream flow within the New Jersey Coastal Plain drains in an easterly direction into Raritan Bay and the Atlantic Ocean while 45% flows toward the Delaware River and Delaware Bay (Vowinkel, et al., 1981). Rollins, which is only 2.5 miles from the Delaware River, lies within the Delaware River Drainage Basin.

b. Geologic Setting

The New Jersey Coastal Plain is underlain by a wedge of unconsolidated sediments that thickens seaward, from a thin veneer at the Fall Line and Delaware River to a thickness of over 6,000 feet at the tip of Cape May County, New Jersey (Richards, Olmsted, and Ruhle, 1962) (Figures 7 and 8). The bedrock surface of this wedge dips gently to the southeast at 10 to 60 ft/mi.

Unconsolidated sediments of the Coastal Plain range in age from Cretaceous to Holocene. For the most part, these sediments are composed of clay, silt, sand, and gravel whose depositional environment ranges from continental to marine-type. The initial deposition of these sediments began during the Late Jurassic or Early Cretaceous during the early stages of the formation of the Atlantic Ocean. Deposition was directly influenced by basement highs and lows which formed as a result of block-faulting during initial sea floor spreading. Basement consists of gneiss and schists (Wissahickon Formation) of Precambrian age. The contact between bedrock and the overlying unconsolidated sediments is usually defined by a saprolite or weathered zone (Zapeczka, 1984).

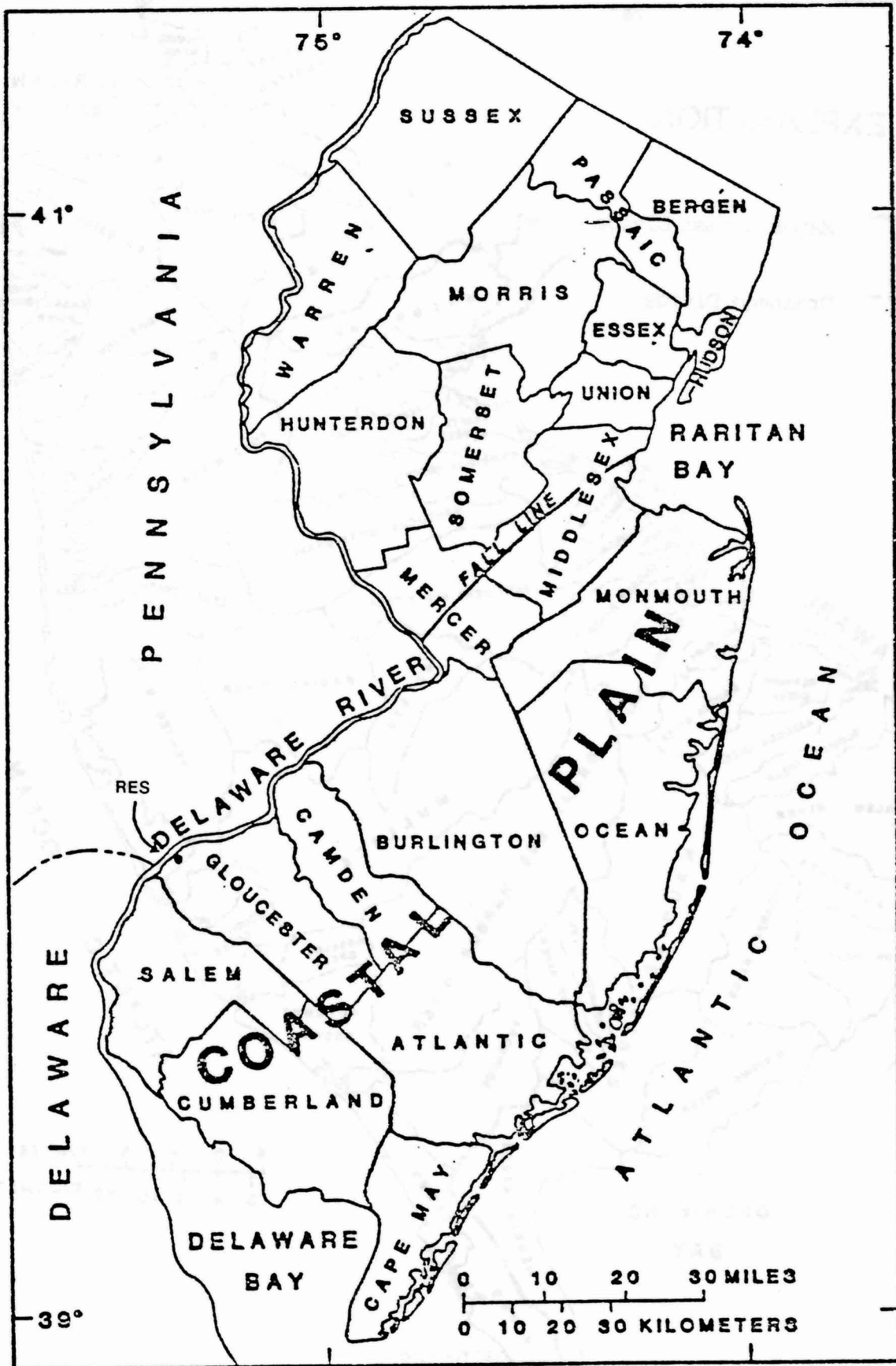


Figure 5. New Jersey Coastal Plain and fall line. From Zapezka (1984).

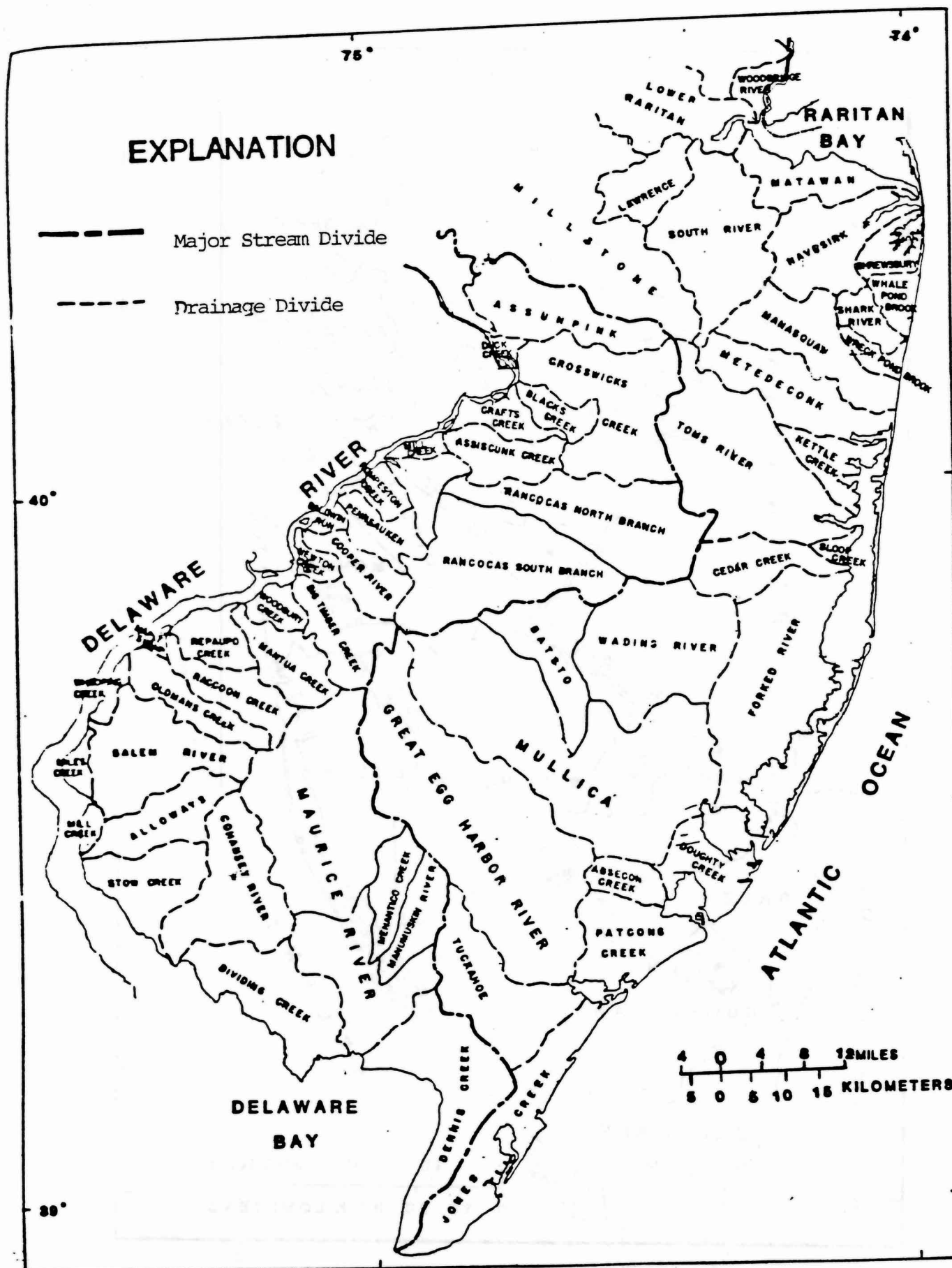


Figure 6. Drainage basins in the New Jersey Coastal Plain. From Volwinkel and Foster (1981).

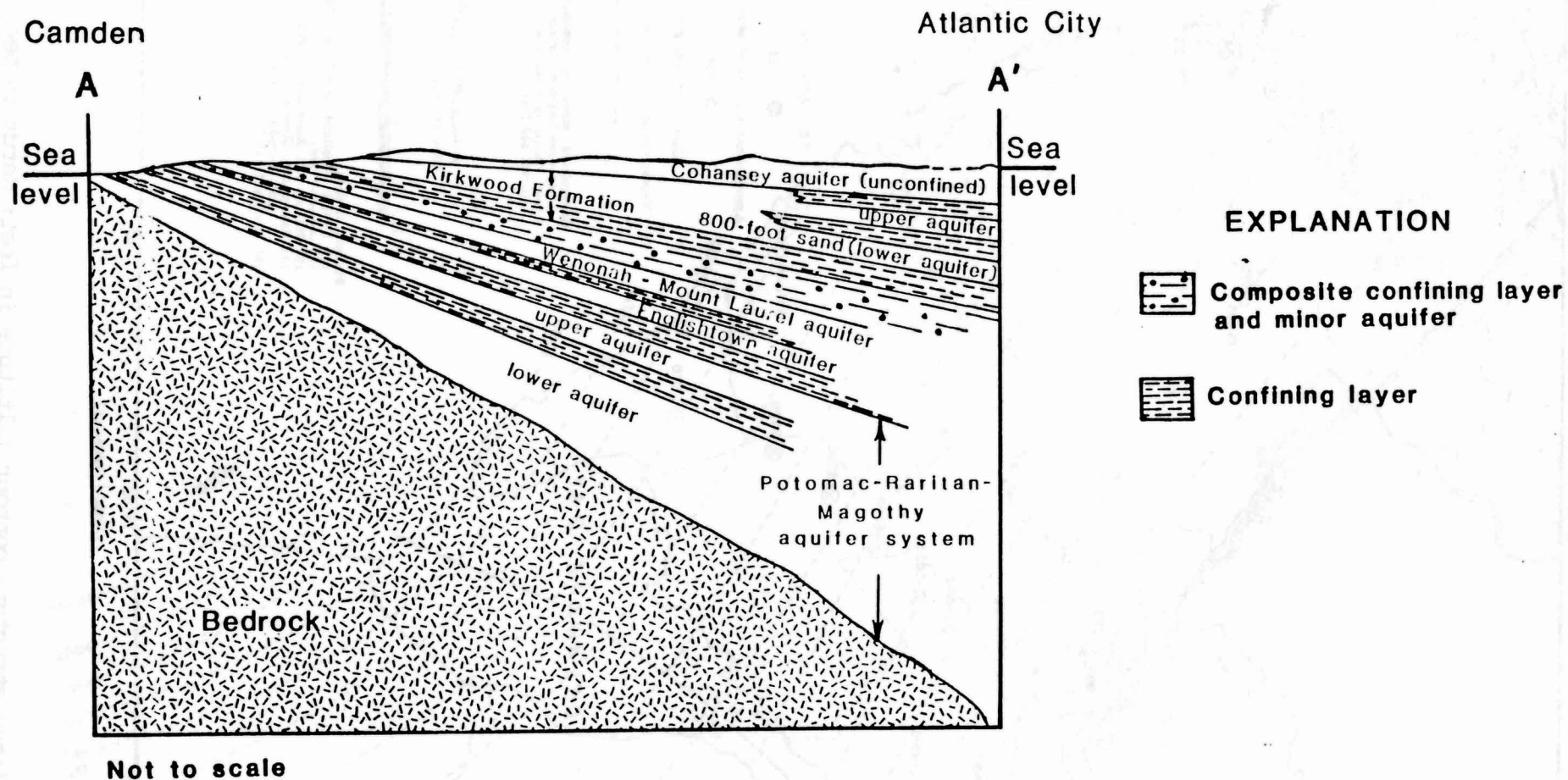


Figure 7. Generalized hydrogeologic cross-section showing dipping bedrock (pre-Cretaceous) and unconsolidated sediments in the New Jersey Coastal Plain. From Walker (1983).

Figure 8. Generalized structure contour (altitude in feet; datum is mean sea level) on pre-Cretaceous bedrock surface in the New Jersey Coastal Plain. From Parker et al. (1964).

the oldest group of sediments deposited on the Precambrian Wissahickon Formation consists of Cretaceous continental deposits of the Potomac Group. This unit consists of alternating clay, silt, sand, and gravel and is a major part of the thick sedimentary wedge in extreme southern New Jersey. The overlying Raritan Formation consists of continental-deltaic deposits which are lithologically similar to the underlying Potomac Group sediments. At depth, however, these sediments contain glauconite and fossils which suggests a none-marine influence. The Magothy Formation unconformably overlies the Raritan Formation and can be described as a transgressive sequence. It consists primarily of beach sands and other associated near-shore marine sediments (Parker et al. 1964). These three, generally non-marine units, make up approximately half the total thickness of coastal plain deposits in New Jersey.

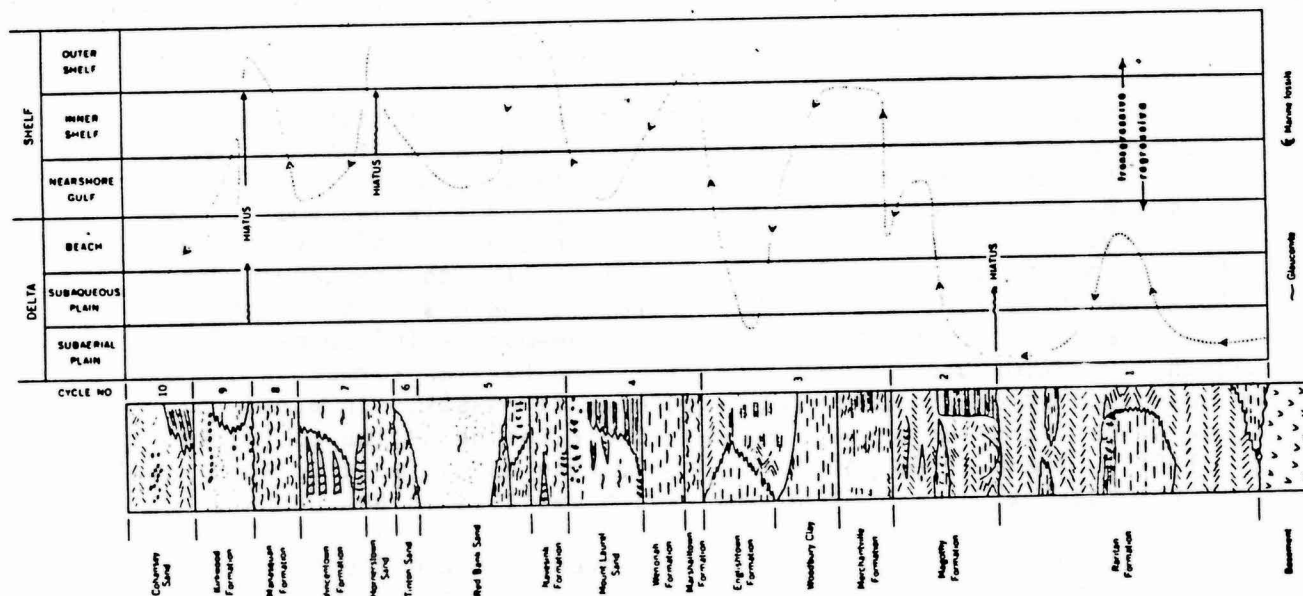
Upper Cretaceous and Tertiary sediments overlying the Magothy Formation were deposited in beach to outer shelf environments caused by alternating transgressive and regressive seas (Owen and Sohl, 1969). Glauconite in association with fine-grained sediments are generally recognized as being indicative of an outer shelf environment. Coarsening-upward sequences, often overlying glauconite rich units, are indicative of transgressive deposits which formed during major incursions by the sea. This mostly marine strata of Late Cretaceous and Early Tertiary age (pre-Miocene) ranges in thickness from about 400 feet near outcrop locations to more than 1,000 feet near the New Jersey shore (Richards et al., 1962).

The long period of marine incursion ended with the deposition of the Cohansey Sand, a non-marine deltaic unit (see Figure 9 for a generalized description of deltaic and shelf transgressive and regressive sequences). Continental deposition continued through Late Tertiary and Quaternary times with recorded thicknesses of up to 1,000 feet in southeastern New Jersey. Many of the later units (Beacon Hill, Bridgeton, Pensauken, and Cape May Formation) are primarily comprised of fluvial sands and gravels. A series of complex Quaternary deposits form a thin veneer over the older sediments and are generally less than 50 feet thick. Holocene age deposits of alluvium are present along the flood plain of the Delaware River and its tributaries. Pleistocene deposits of possible glacial origin (glacial outwash streams and channels) as well as fluvial/marine deposits extend beneath the Delaware River (see Figure 10 for a description of geologic and hydrogeologic units in the New Jersey Coastal Plain).

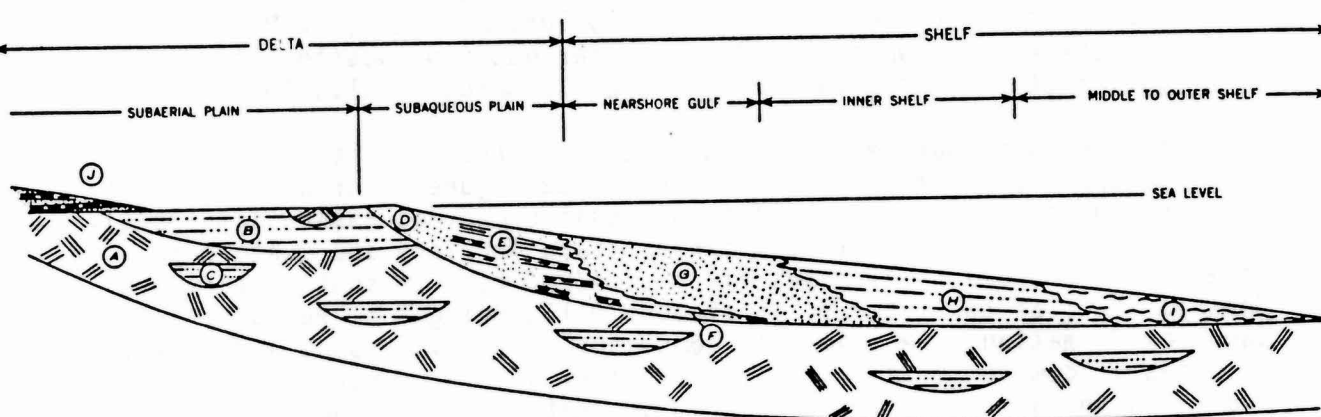
c. Hydrogeologic Setting

The sediment wedge of the New Jersey Coastal Plain comprises one interrelated aquifer system that includes several aquifers and confining units. The boundaries of aquifers and confining beds may not necessarily correspond to geologic formations because formations may be divided into several hydrologic units and may change in physical character laterally (which affects their hydrologic characteristics). There are five major aquifers in the New Jersey Coastal Plain: Potomac-Raritan-Magothy aquifer system,

(a)



(b)



EXPLANATION

A. Channel fill Point bar — Raritan, Magothy and Englishtown Formations and Cohansay Sand
 B. Overbank Mangrove swamps — Raritan Formation
 C. Overbank Floodbasin — Raritan and Magothy Formations
 D. Beach — Englishtown Formation and Cohansay Sand
 E. Topset delta — Magothy and Englishtown Formations, and Mount Laurel Sand
 F. Bottomset delta — Merchantville Formation

G. Nearshore gulf — Mount Laurel and Red Bank Sands, and Vincentown, Manasquan and Kirkwood Formations
 H. Inner shelf — Merchantville Formation, Woodbury Clay, Englishtown and Wenonah Formations, Red Bank Sand and Vincentown, Manasquan and Kirkwood Formations
 I. Outer shelf — Merchantville, Marshalltown, Neversink Formations and Hornerstown Sand and Manasquan Formation
 J. Overbank Natural levee — Raritan and Magothy Formations

Figure 9. Both (a) and (b) are diagrammatic representations of depositional environments which existed during the emplacement of Cretaceous and younger sediments in the New Jersey Coastal Plain. From Owens and Sohl (1969).

SYSTEM	SERIES	GEOLOGIC UNIT	LITHOLOGY	HYDROGEOLOGIC UNIT	HYDROLOGIC CHARACTERISTICS				
Quaternary	Holocene	Alluvial deposits	Sand, silt, and black mud.	Undifferentiated	Surficial material, often hydraulically connected to underlying aquifers. Locally some units may act as confining beds. Thicker sands are capable of yielding large quantities of water.				
		Beach sand and gravel	Sand, quartz, light-colored, medium- to coarse-grained, pebbly.						
	Pleistocene	Cape May Formation							
Tertiary	Miocene	Pensaiken Formation	Sand, quartz, light-colored, heterogeneous, clayey, pebbly.	Kirkwood-Cohansey aquifer system	A major aquifer system. Ground-water occurs generally under water-table conditions. In Cape May County the Cohansey Sand is under artesian conditions.				
		Bridgeton Formation							
		Seacon Hill Gravel	Gravel, quartz, light colored, sandy.						
		Cohansey Sand	Sand, quartz, light-colored, medium to coarse-grained, pebbly; local clay beds.						
		Kirkwood Formation	Sand, quartz, gray and tan, very fine- to medium-grained, micaceous, and dark-colored diatomaceous clay.						
	Eocene	Piney Point Formation	Sand, quartz and glauconite, fine- to coarse-grained.	Composite confining bed	Piney Point aquifer	Yields moderate quantities of water locally.			
		Shark River Formation	Clay, silty and sandy, glauconitic, green, gray and brown, fined-grained quartz sand.						
		Manasquan Formation							
		Paleocene	Vincentown Formation				Sand, quartz, gray and green, fine- to coarse-grained, glauconitic, and brown clayey, very fossiliferous, glauconite and quartz calcarenite	Vincentown aquifer	Yields small to moderate quantities of water in and near its outcrop area.
			Hornerstown Sand				Sand, clayey, glauconitic, dark green, fine- to coarse-grained.		
Cretaceous	Upper Cretaceous	Tinton Sand	Sand, quartz, and glauconite, brown and gray, fine- to coarse-grained, clayey, micaceous.	Composite confining bed	Red Bank sand	Yields small quantities of water in and near its outcrop area.			
		Red Bank Sand							
		Navesink Formation	Sand, clayey, silty, glauconitic, green and black, medium- to coarse-grained.						
		Mount Laurel Sand	Sand, quartz, brown and gray, fine- to coarse-grained, slightly glauconitic.						
		Wenonah Formation	Sand, very fine- to fine-grained, gray and brown, silty, slightly glauconitic.						
		Marshalltown Formation	Clay, silty, dark greenish gray, glauconitic quartz sand.						
		Englishtown Formation	Sand, quartz, tan and gray, fine- to medium-grained; local clay beds.						
		Woodbury Clay	Clay, gray and black, micaceous silt.						
		Merchantville Formation	Clay, glauconitic, micaceous, gray and black; locally very fine-grained quartz and glauconitic sand.						
		Magothy Formation	Sand, quartz, light-gray, fine- to coarse-grained; local beds of dark-gray lignitic clay.						
	Lower Cretaceous	Raritan Formation	Sand, quartz, light-gray, fine- to coarse-grained, pebbly, arkosic, red, white, and variegated clay.	Potomac-Raritan Magothy aquifer system	upper aquifer	A major aquifer system. In the northern Coastal Plain the upper aquifer is equivalent to the Old Bridge aquifer and the middle aquifer is the equivalent of the Farrington aquifer. In the Dela. River Valley three aquifers are recognized. In the deeper subsurface, units below the upper aquifer are undifferentiated.			
							conf bd		
							middle aquifer		
							conf bd		
							lower aquifer		
Pre-Cretaceous		Bedrock	Precambrian and lower Paleozoic crystalline rocks, metamorphic schist and gneiss; locally Triassic basalt, sandstone and shale.	Bedrock confining bed	No wells obtain water from these consolidated rocks, except along Fall Line.				

¹ Rio Grande water-bearing zone.

² ----- Minor aquifer not mapped in this report.

Figure 10. Geologic and hydrogeologic units of the New Jersey Coastal Plain. From Zapezka (1984).

Englishtown aquifer, Wenonah-Mount Laurel aquifer, Lower "800-foot" Sand aquifer of the Kirkwood Formation and the Kirkwood-Cohansey aquifer (Vowinkel and Foster, 1981).

In New Jersey, sediments of the Cretaceous Potomac Group, Raritan, and Magothy Formations are usually described as one aquifer unit or as an aquifer system (Zapeczka, 1984) because the individual formations are lithologically indistinguishable from one another over large areas of the southern Coastal Plain (see Figure 11 for a description of extent, thickness, and subsurface configuration). In the region between Trenton and Delaware Bay, the aquifer system can be divided into five units: three aquifers, designated lower, middle, and upper, and two confining beds. In the study area, which lies in Gloucester County, however, these subdivisions are not apparent.

The important aquifer systems in Gloucester County are the Potomac Group and Raritan-Magothy Formations (Cretaceous), the Wenonah Formation and the Mount Laurel Sand (Cretaceous), Vincentown Formation (Tertiary), Cohansey Sand (Tertiary) and the Cape May Formation (Quaternary). Of the water bearing formations, the Potomac Group and the Raritan and Magothy Formations contain the most productive aquifers in Gloucester County. The system yielded over 25 million gallons per day in 1978 in Gloucester County (Vowinkel and Foster, 1981). Regional aquifer tests indicate transmissivities upwards of 30,000 gpd/ft and storage coefficients ranging from .000033 to .004 (Meisler in Gill et al., 1976). This aquifer system, which crops out in a narrow 3 to 5 mile wide band adjacent to the Delaware River in southwestern Jersey (Figure 11), is the most heavily pumped system in New Jersey.

The geohydrology is more complex within the outcrop area (western Gloucester County) than downdip of it (Fusillo et al., 1984). In the outcrop area, confining units are thinner; thus, hydraulic connections between aquifers is more likely. Numerous lenses of sand and clay occur locally. In much of the outcrop area, the Cretaceous aquifer system is overlain by a thin veneer of post-Cretaceous deposits, most of which are hydraulically connected to the underlying aquifer. The aquifers in Gloucester County are recharged by precipitation entering the uppermost aquifer through outcrops and overlying permeable units. Ground water is generally discharged to streams and wells, leakage to other aquifers, and evapotranspiration.

Precipitation, the source of all freshwater inflow to the Coastal Plain, averages 44 inches per year in Gloucester County. A large percentage of streamflow runoff is derived from ground water discharge into stream channels. The upper geologic units are able to transmit large quantities of water downward to the saturated zone. In the outcrop areas of the Potomac-Raritan-Magothy aquifer system where the system is unconfined, the recharge to ground water is 12 inches per year (Farlekas, 1979). Variations in recharge are a result of the slope of the land surface, permeability of the sediments, and the degree of urbanization.

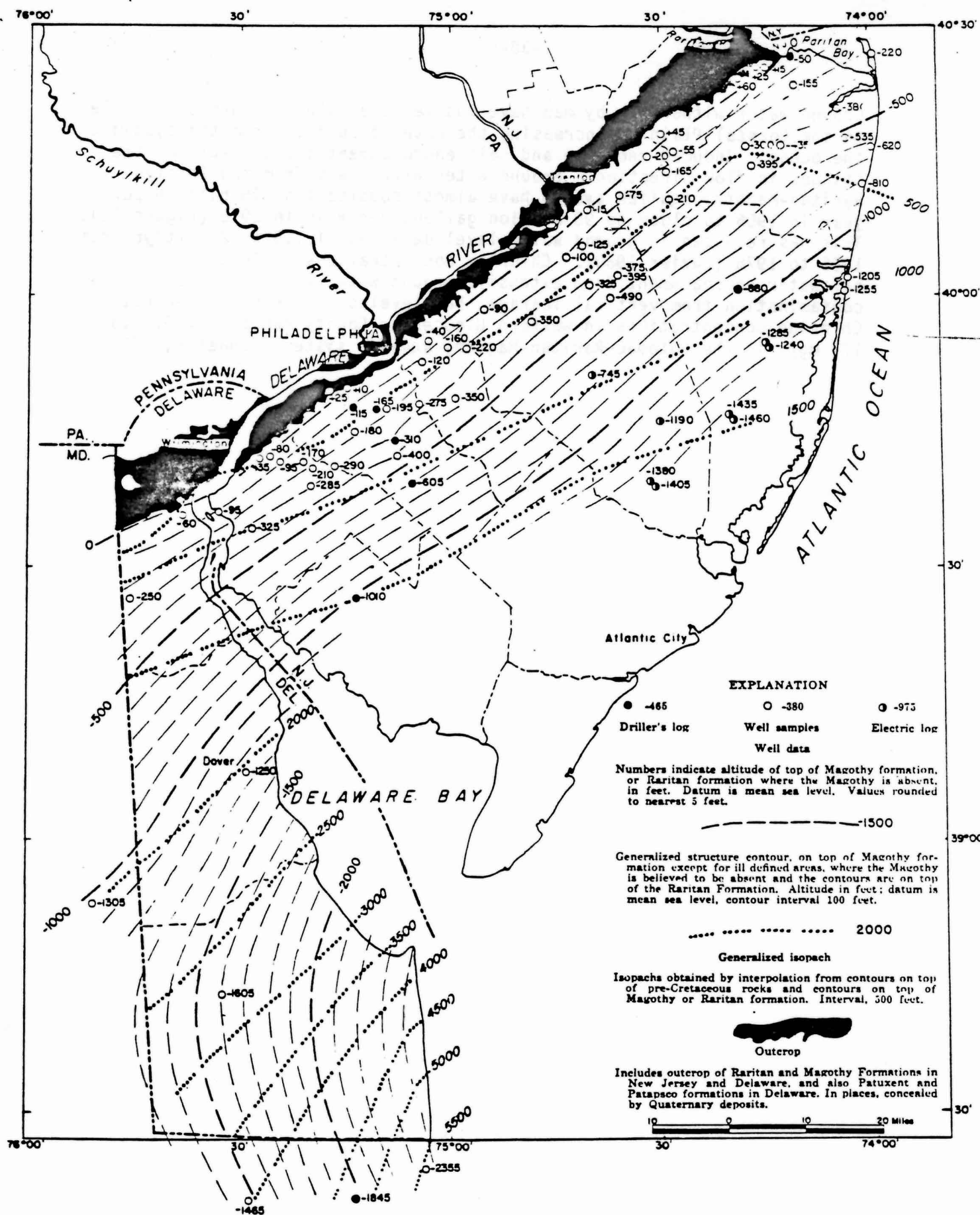
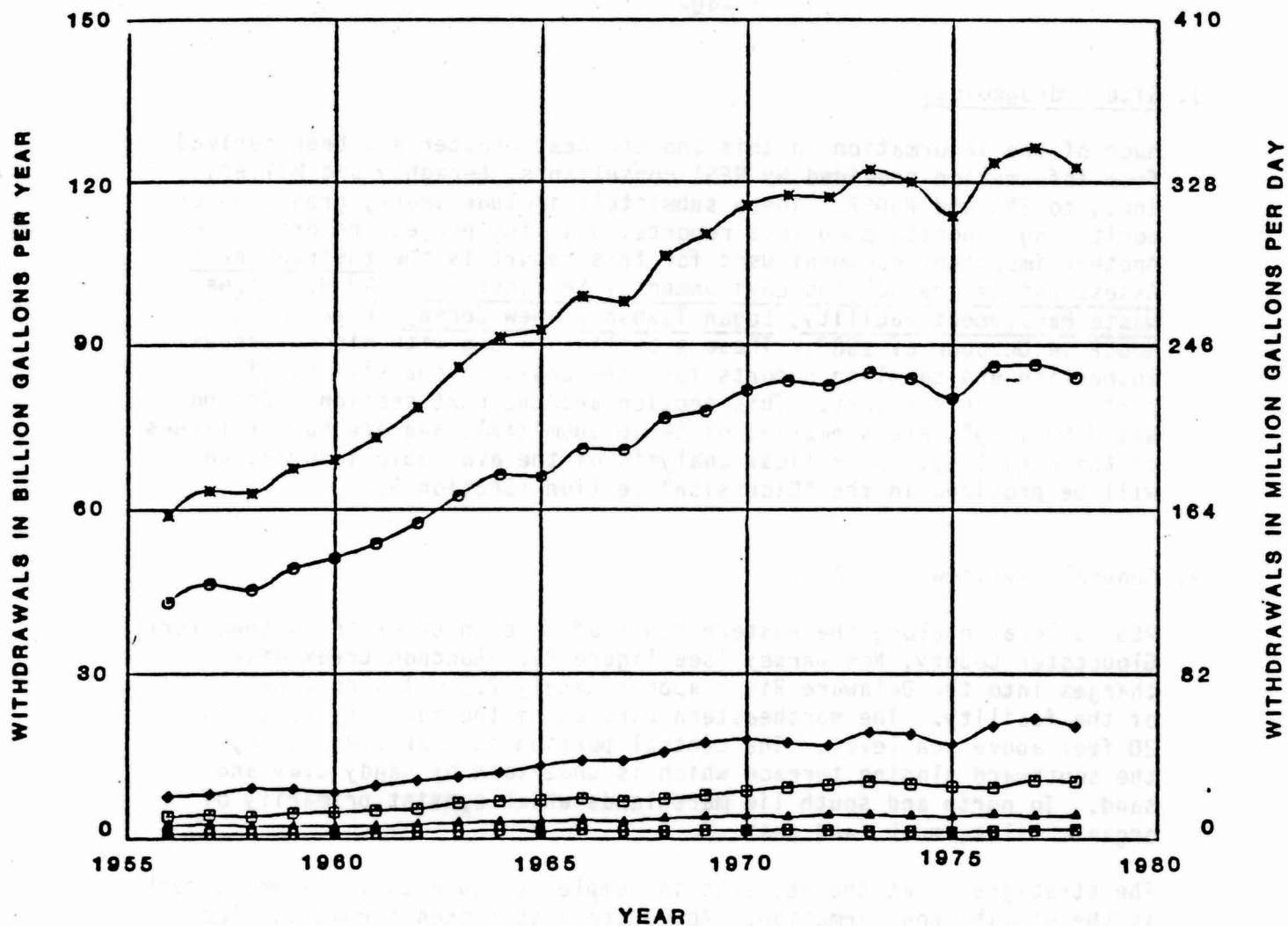


Figure 11. Generalized structure contour (altitude in feet; datum is mean sea level) on top of the Magothy formation along with isopachs of the combined Potomac Group, Raritan and Magothy formations. From Parker et al. (1964).

Ground water withdrawals by man have modified the natural hydrologic cycle in the Coastal Plain by increasing the rate of outflow from the system to the ocean. Induced recharge and salt encroachment are a result of the changes in flow direction. Ground water withdrawals from the Potomac-Raritan-Magothy aquifer system have almost doubled from 45 billion per year in 1956 to close to 90 billion gallons per year in 1978 (Figure 12). This has resulted in ground water level declines of 1.5 to 2.5 ft/yr from 1966 to 1976 (Luzier 1980). Chloride concentrations, a function of saltwater encroachment from extensive ground water withdrawals as well as contamination from vertical leakage, has leveled off in recent years. Chloride concentrations in western Gloucester County range from 0.4 to 177 mg/l in the Potomac-Raritan-Magothy aquifer system (Schaefer, 1983).



EXPLANATION

* Total

Aquifer

○ = Potomac-Raritan-Magothy System

△ = Englishtown

⊠ = Wenonah-Mount Laurel

□ = Lower "800-foot" Sand of the Kirkwood Formation

◆ = Kirkwood-Cohansey

Figure 12. Major ground water withdrawals from the New Jersey Coastal Plain, 1958-1978. From Volwinkel and Foster (1981).

3. Site Hydrogeology

Much of the information in this and the next chapter has been derived from information provided by RES' consultants, Geraghty and Miller, Inc., to EPA and NJDEP. These submittals include yearly ground water monitoring reports, pump test reports, drilling project reports, etc. Another important document used for this report is the Environmental Assessment of the Rollins Environmental Services (RES) NJ Hazardous Waste Management Facility, Logan Township, New Jersey prepared by NJDEP in October of 1983. These submittals along with miscellaneous inspection and sampling reports form the basis of the site specific portions of this report. This section and the next section, "Ground Water Quality", are summaries of these submittals and are not critiques of their quality. A critical analysis of the available information will be provided in the "Discussion" section (Section 5).

a. General Overview - Geology

RES is located along the eastern banks of Raccoon Creek in northwestern Gloucester County, New Jersey (see Figure 2). Raccoon Creek discharges into the Delaware River approximately 2.2 miles northwest of the facility. The northeastern portion of the facility is 10 to 20 feet above sea level. The central portion is characterized by the southward sloping terrace which is underlain by sandy clay and sand. To north and south lie marshlands which consist primarily of organic silts, muck, and peat.

The stratigraphy at the RES site is complex (Figure 13). Basement rock is the Wissahickon Formation. Above the Wissahickon Formation lies an unconsolidated group of sediments ranging in age from Early Cretaceous to Recent. The expected depth to the Wissahickon Formation is approximately 250 feet below sea level at the site (NJ Geol. Survey Rep. 4); the contact between it and the overlying unconsolidated sediments is believed to be a weathered mica schist (saprolite). A regressional period during the Jurassic probably caused erosion of the Wissahickon surface and its redeposition as a veneer of disaggregated material up to 30 feet thick. This veneer of sediments is encountered in wells drilled through Coastal Plain material into the Wissahickon Formation. Highland areas to the north and east were the provenance for sediments deposited during the Cretaceous and Quaternary Periods. The Raritan Formation in the vicinity of RES is characterized by light colored sands and silty clay thought to represent river channel and floodplain depositional environments of the Cretaceous Period. As will be discussed later, there is no strong evidence to suggest the existence of any continuous clay layers beneath the site area. While clay does exist, thicknesses and elevations are not consistent among well logs. It is not certain whether the Cape May Formation, often indistinguishable from the underlying Raritan Formation, is present at the RES site. Cape May sands and clays are washed or wind blow sediment of non-glacial origin which are usually found on low terraces and plains.



Recent deposits are related to the flooding of Raccoon Creek Valley during the post-glacial rise in sea level. These sediments can be subdivided into a basal sand, an intermediate clayey sand, and overlying silts and muck. These differences are a result of depositional environment, the coarser material being deposited in stream channels or along estuary shorelines and the finer silts being deposited offshore in quieter water. Organic silts, mucks, and peats were deposited in adjacent marsh areas. all of these recent sediments slope towards Raccoon Creek.

b. General Overview - Hydrogeology

The Cretaceous through Quaternary age deposits have been divided into three waterbearing zones at the RES site: the water table zone, the shallow artesian zone, and the deep artesian zone. Because of the deep artesian zone's naturally poor water quality it will not be discussed further. The water table zone is an unconfined aquifer which is recharged by precipitation through the overlying Recent sediments. Topographic low areas such as streams and marshes are ground water discharge points. The top of the water table average 1 to 3 feet above sea level; the zone is generally 25 to 30 feet thick and, locally, 45 to 50 feet thick. Differences in thickness are a function of the irregular occurrence of clay layers and lenses and differences in topography. The zone is generally thicker in the North Marsh Area.

The shallow artesian zone is a deeper aquifer at the RES site. It is semi-confined since a continuous clay confining unit does not exist immediately above the unit throughout the site. The shallow artesian system is recharged by vertical leakage from the water table zone. Minor contamination in the shallow artesian zone is further evidence that the water table zone directly recharges this zone. The downward component of flow may be reversed locally with heavy pumpage in the water table zone. The shallow artesian zone discharges to Raccoon Creek. Because of the variable vertical and horizontal extent of clay layers and lenses, the top of the shallow artesian zone is difficult to determine. According to RES' consultants, the top of the zone lies 68 to 73 feet below sea level. Its thickness, as determined from one log of an abandoned production well, is approximately 53 feet.

RES performed short-term well tests in 1982 on both abatement and artesian zone wells. The range of calculated transmissivities in the water table zone is 3,000 gpd/ft to 27,000 gpd/ft with corresponding hydraulic conductivities of 150 gpd/ft² to 625 gpd/ft². The higher conductivities and transmissivities are for ground water in the North Marsh Area where the sandy units are generally coarser and thicker. In a long-term well test on shallow artesian well DP4 it was determined that there is some interconnection between the water table zone and the shallow artesian zone. The calculated hydraulic conductivity in the shallow artesian zone

is 1,700 gpd/ft² while, based on an aquifer thickness of 53 feet, the transmissivity of the zone is 90,000 gpd/ft. Because of the complex geology, it is difficult to correlate these local saturated zones to regional hydrogeologic formations. The shallow artesian zone may correlate to the upper reaches of the Potomac-Raritan-Magothy system while the water table zone is probably equivalent to the later Quaternary desposits. It should be emphasized that geologic and hydrogeologic information regarding the shallow artesian zone comes from only 5 deep wells. Its thickness, which is used to determine the zone's transmissivity, derived from the drill log of one out of service production well.

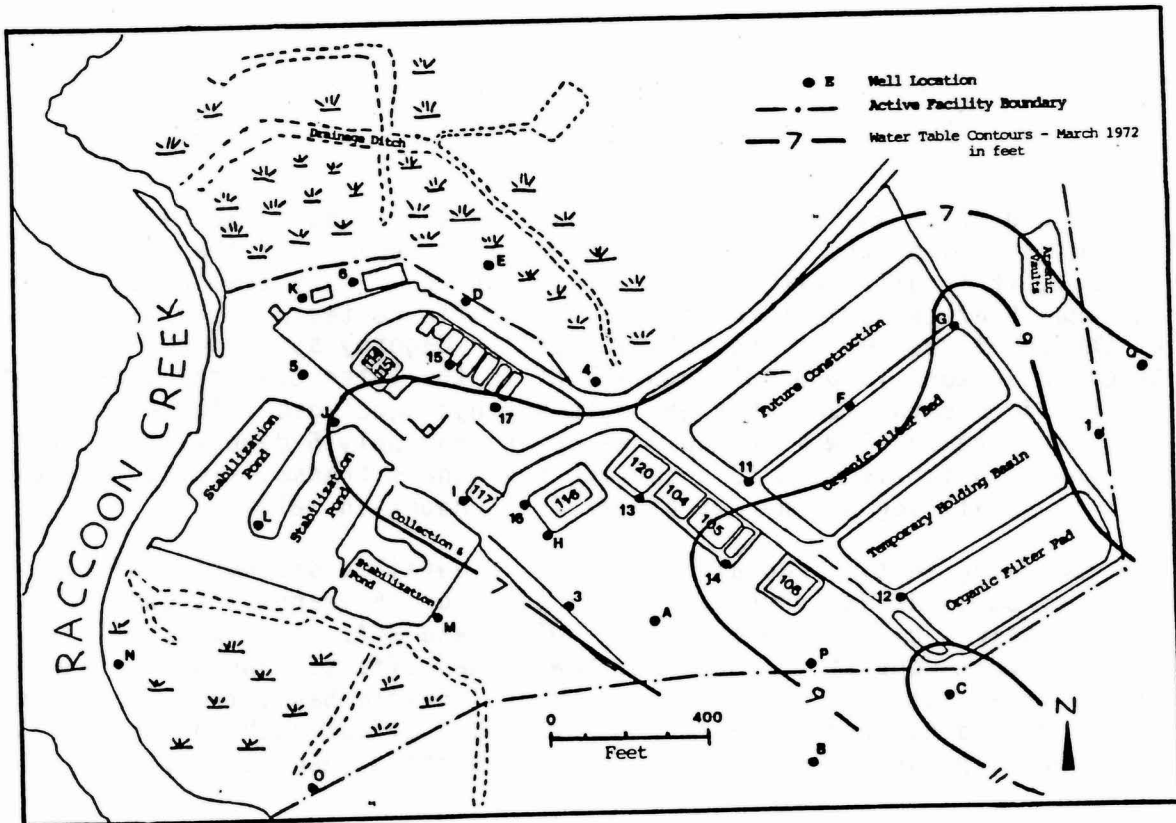
The following section contains a much more detailed discussion of site hydrogeology. It is essentially a synopsis of 15 years of ground water investigations by RES' consultants, NJDEP, and EPA. The focus will be on specific work done at the site and how it has affected our understanding of the area. It will also describe the scientific basis from which many of these findings were derived. A more critical approach to the same topic will be the main concern of the "Discussion" section (Section 5).

c. Hydrogeology and RES' Ground Water Monitoring Program

In February, 1970, RES (then known as Rollins-Purle, Inc.) drilled a deep production well and several shallow observation wells. The production well was 290 feet deep and drill logs describe bedrock at 270 feet. To this day, the production well (now sealed) is the only well to have penetrated the whole unconsolidated sedimentary sequence and the underlying Wissahickon Formation. In February, 1972, RES contracted Geraghty and Miller, Inc. (G & M) to study the ground water conditions at the facility. G & M submitted a report in April, 1972, describing ground water conditions and hydrogeology. As part of this project wells were installed at 18 locations (designated A through Q), and at each location, one or more such wells were screened at depths ranging from 5 to 30 feet. Using the results of this testing program and using well logs from previous production and observation wells, G & M concluded that "the western portion of the facility consists of predominantly clay grading to sand to the east and that shallow sands are underlain by a more or less continuous clay zone." Most sediments were generally of low permeability.

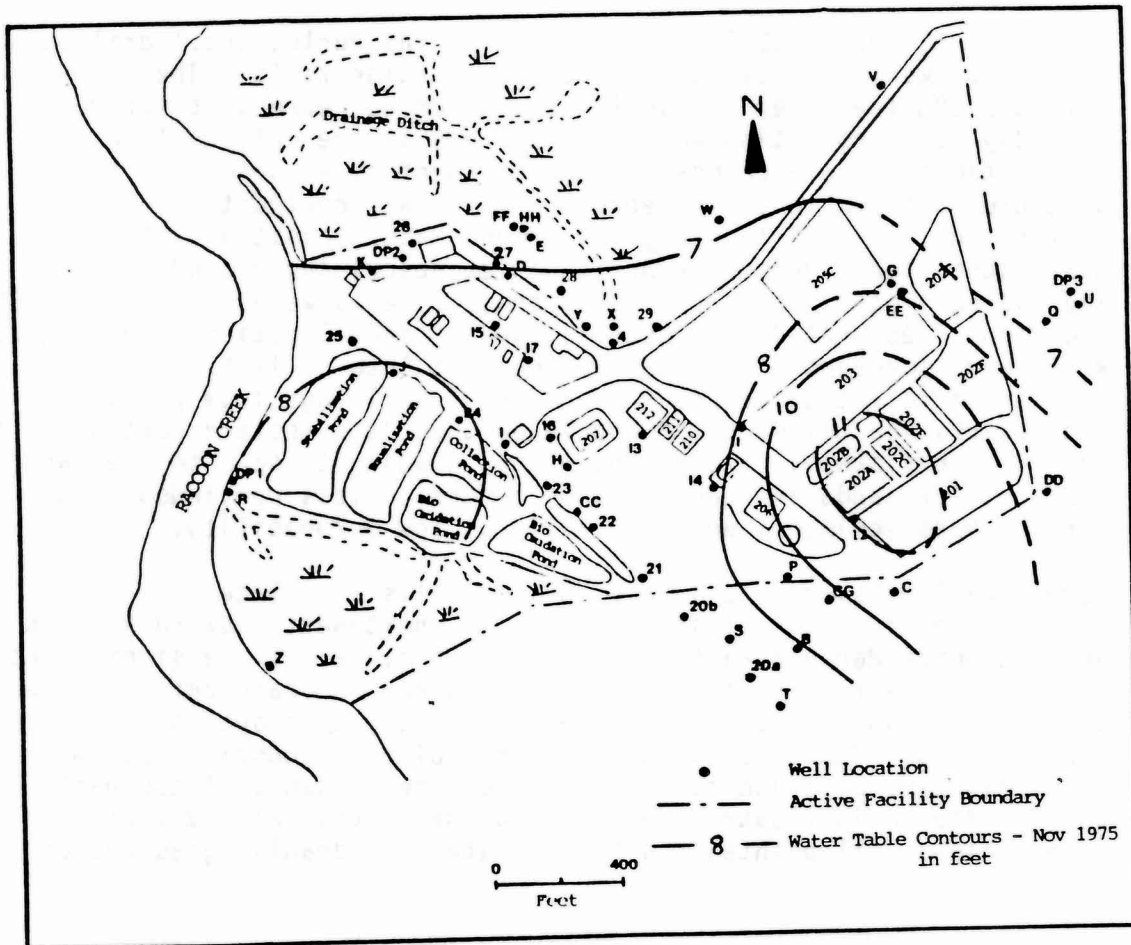
Water level measurements in the shallow wells show lateral movement of ground water from the vicinity of Well C, northwest, toward Raccoon Creek and the North Marsh Area (Figure 14a). These levels are significant in that there are true static water levels since no abatement wells were yet in place and the production well was not yet in operation to affect measurements. There is already evidence of some mounding near Well C which may have been due to activities at the "organic filter pad", now part of the Basin Closure Area. Using the ground water elevation data from various well points, G & M calculated a hydraulic gradient of 0.0025.

(a)



Rollins Environmental Services Facility Map - 1972

(b)



Rollins Environmental Services Facility Map - 1980

Figure 14. Water table contour maps (altitude in feet; datum is mean sea level) for (a) March, 1972 and (b) November, 1975.

After assuming a low permeability of 100 gpd/ft² (hydraulic conductivity) and a 10 foot upper aquifer thickness (now called the "water table zone"), G & M calculated the discharge to Raccoon Creek to be approximately 5,000 gpd. Because wells were screened at different elevations (at the same location), vertical gradients could be estimated. G & M concluded that "there is some order of downward component of flow." As a result of the initial evaluation, 6 abatement wells (Wells 20 through 25) were installed to form a barrier against the movement of contaminated ground water towards Raccoon Creek. The implementation program called for each abatement well to be pumped for 12 hours per day at a rate of 20 gpm to yield 14,400 gpd. According to G & M, this rate would be well over the estimated ground water discharge (5,000 gpd) into Raccoon Creek.

In October, 1975, DP1 and DP2 were installed to monitor the shallow artesian zone. A short-term well test was conducted on each abatement well to determine whether clogging had occurred within the well screens. As a result, redevelopment was initiated; however, well efficiency did not improve sufficiently. Static water level measurements were taken which more clearly delineated a ground water mound centered beneath basins B-202A and B-201 (Figure 14b). During this study G & M recommended that 4 more wells be added to the abatement system. They were installed in April-May, 1976, and designated 20A, 20B, 26 and 27; thus, the number of wells in the abatement system increased to 9. Concurrently, the pumping rate was increased to 22,000 gpd. Ground water pumped by the abatement wells was discharged into a common collection system and then piped into the equalization basin B-206 for biological treatment. All 9 wells are 4" diameter with 10 feet of screen installed in the water table zone. They were drilled 20 to 25 feet from ground surface corresponding to 15 to 20 feet below sea level. These newer wells were constructed of PVC; the first 5 wells, however, were constructed of fiberglass. Composition of the original well points is uncertain as many of the logs no longer exist and many of the wells have been pulled out of the ground.

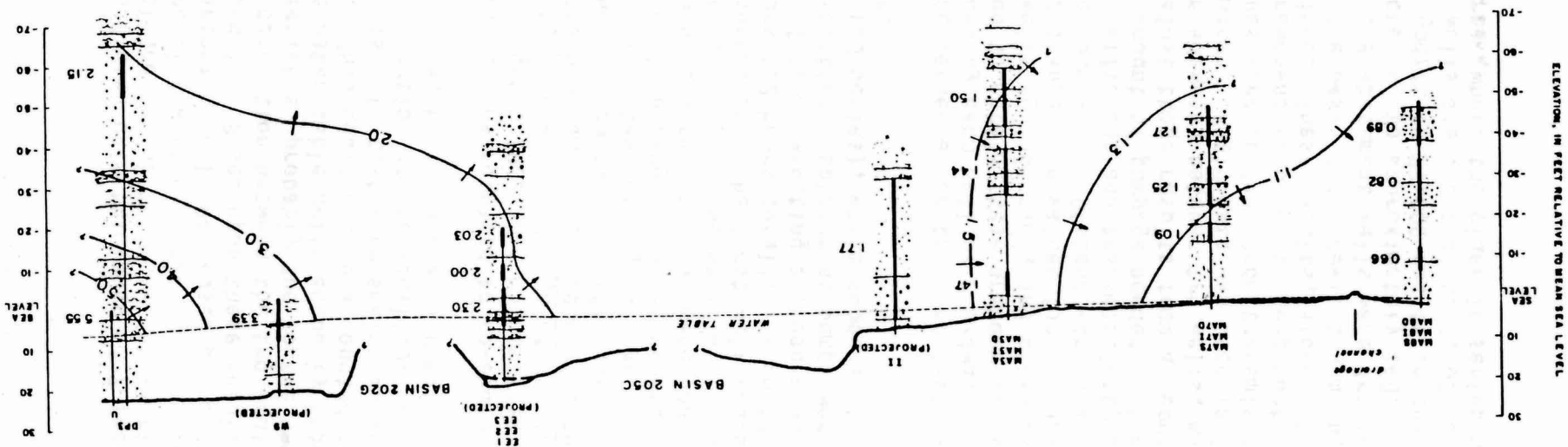
Also part of this project was the installation of 6 monitoring wells (R-W). A well test was conducted, utilizing the Main Production Well for pumping and using DP1, DP2, and 17 as observation wells. The purpose of the test was to determine the transmissivity of the shallow artesian zone. The pump test lasted 100 minutes during which time the Main Production Well was pumped at a constant rate of 190 gpm. Drawdown at DP2, 14 feet from the Main Production Well, was 5 feet; drawdown at DP1, 950 feet away, was 0.06 feet; there was no measured drawdown in Well 17 which is 500 feet away and screened in the water table zone. From these results G & M calculated the transmissivity of the shallow artesian zone to be 16,000 gpd/ft. Continuous water level recorders were installed in DP1, DP2, and Well 17 to determine the hydraulic gradient between the water table and shallow artesian zone. This was done over the period January 29 to February 5, 1976, prior to the well test. Tidal effects were evident (1 to 2 feet) in Wells DP1 and DP2; these effects were negligible in Well 17. Due to maintenance problems, the pumping/abatement

system was not in operation during early 1978; therefore, the March, 1978, water table map represents approximate natural flow conditions. Mounding is apparent near basins B-210, B-211, and B-212.

In order to determine ground water flow direction in the shallow artesian zone, RES installed a third deep well (DP3) in 1979. From the three deep wells it was determined that ground water flow in this zone is towards the west, to Raccoon Creek. The screened interval of DP3 is shallower (53'- 63' bsl) than the previously installed wells, DP1 and DP2 (75'- 85' and 72'- 82' bsl respectively). Because of contamination in the northern section of the facility, two more abatement wells (28 and 29) were also installed, increasing the total number of abatement wells to 11.

In the summer of 1981, as part of an investigation into possible contamination in the North Marsh Area, RES installed 11 well clusters (3 wells - shallow, intermediate, and deep, in 11 locations). The wells are 1.25 to 1.50 inches in diameter and constructed of PVC. Well screens are 5 to 10 feet in length and are all located in sandy units at depths between 2 and 67 feet below sea level. The following summer (1982) water level measurements from the marsh wells (called the MA series) were used along with measurements from older wells in the Basin Closure Area to construct a hydrogeologic cross-section. RES' consultants determined that there is a downward component of ground water flow beneath the Basin Closure Area and an upward component in the North Marsh Area (Figure 15).

RES' ground water monitoring system changed significantly in late 1981, when, as part of a Consent Agreement signed with NJDEP, RES was required to more adequately define site hydrogeology and to upgrade the existing abatement system. Pursuant to the Order, RES conducted a shallow artesian well test and a series of short term well tests on all abatement wells. The purpose of the shallow artesian well test was to determine the transmissivity and storage coefficient of the shallow artesian zone, the leakage rate of any overlying confining unit, and the probable effect of pumping the shallow artesian zone on the water table aquifer. A new well, DP4, was installed as the pumping well. Observation wells included AV1, AV2, W7, W11, W12, W18, U, DD, BB, II, EE, R, 11, DP1, DP2, DP3, and DP5, (another new well). DP4 was pumped at constant rate (300 gpm) for 29.5 hours. Stevens automatic water level recorders were used at all the deep wells. All data was presented on semi-log paper, and results from DP3 were used to calculate aquifer parameters. DP3 was chosen because it is minimally influenced by tides. Unfortunately, DP3 is not in the RES waste management area. Quantitative results were determined by curve matching DP3 data to leaky artesian type curves of Walton, 1970. The transmissivity of the shallow artesian zone was determined to be 90,000 gpd/ft with a storage coefficient of 4.6×10^{-4} , and leakage from the confining unit was determined to be 9.7×10^{-3} gpd. The horizontal permeability of the shallow artesian zone was 1,700 gpd/ft², and the vertical permeability of the confining unit, 0.068 gpd/ft²; permeability data was determined using an

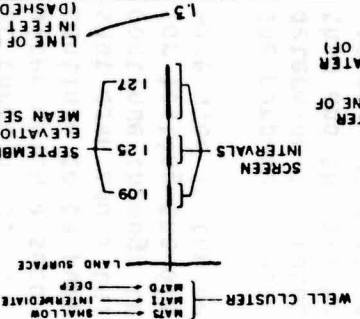


Note: This section is not corrected for anisotropy. As the vertical permeability of the unconsolidated deposits is significantly less than the horizontal permeability, the vertical flow component shown in the section is exaggerated.

EXPLANATION

- ORGANICS
- SAND (FINE TO MEDIUM)
- SAND (MEDIUM TO COARSE)
- GRAVEL
- CLAY
- SILT

— DIRECTION OF GROUNDWATER FLOW PARALLEL TO PLANE OF SECTION
 - - - DIRECTION OF GROUNDWATER FLOW OBLIQUE TO (OUT OF) PLANE OF SECTION



Hydrogeologic Cross-section from Geraghty and Miller, Dec., 1982

Figure 15

quifer thickness of 53 feet and a confining unit thickness of 7 feet. An analysis of this data will be included in the "Discussion" section (Section 5). The rest of the test results were used for qualitative purposes only. Pumping of shallow artesian well DP4 caused a drawdown in water table wells AV1, EE, W12, II and 11. Based upon these results, RES concluded that there is a hydraulic connection between the two aquifer zones. The amount of drawdown was variable, probably due to the heterogeneity of subsurface geology. Some water table wells actually showed a rise in water levels during pumping. This could not be accounted for. Most of the shallow wells used for this well test were sealed during the closure of the basins in the northern portion of the facility. Of the 13 water table zone wells, only 6 (DD, GG, R, U, II, and W18) remain.

Also as part of the Order with NJDEP, RES was required to re-evaluate the contamination abatement program. In August, 1982, G & M submitted the project report, Abatement Well Testing Program and Design of Pumping Schedule. The specific purpose of the program was to "determine pumping rates required to alter the ground water flow system sufficiently to create a pumping barrier to the flow of contaminated ground water off the property and to establish an operational pumping schedule for RES' subsequent use." Abatement wells 20 through 25 were tested as were new wells 30 through 33. The general approach was to pump one well for 6 hours, after which a second well would be turned on. The first well would continue to be pumped for 6 more hours (12 hours total). It would then shut down and a third well started. This alternating procedure would continue through the entire test. Positive displacement pumps were used for testing the old abatement wells (20 series), while submersible pumps were used in the new 30 series wells.

The purpose of using this alternating sequence for the pump tests was to determine the mutual drawdown produced by each well pair midway between them and the discharge rates required to obtain these drawdowns. Drawdown values were plotted for individual wells against time, and drawdowns for several wells were plotted against distance (the values for drawdown vs. distance were taken after 12 hours of pumping). Distance-drawdown graphs were used to determine the storage coefficient and transmissivity of the zone being pumped. By checking the amount of pumpage needed in the field to produce the required drawdown against those results from an equation from Todd (1959) describing drawdown adequacy between two wells, maximum required discharge rates were determined. Field data was used in Todd's formula; hydraulic conductivity values were derived from transmissivities. Through this process, the minimum drawdowns required to keep contaminants from migrating off-site were determined. These results, along with field derived hydraulic gradients, formed the basis for a revised pumping schedule. Based on the results, 2 more abatement wells were drilled (34 and 35), and total daily pumpage increased to approximately 140,000 gpd. Transmissivities ranged from 13,000 gpd/ft to 27,000 gpd/ft in the North Marsh Area (where the new 30 series wells are located) to 3,000gpd/ft to 8,200 gpd/ft in the Central Plant Area (where the older 20 series wells

are located). RES determined that water table zone thickness in the North Marsh Area is 30 to 40 feet and decreases in the Central Plant Area to 15 to 25 feet. A more detailed discussion of test methods, interpretations, and underlying assumptions, will be presented in Section 5.

The pumping schedule originally designed and implemented through the 1982 Abatement Well Report is the one currently being used. Approximately 4 million gallons of contaminated ground water per month are pumped into the RES water treatment facility and, from there, discharged into Raccoon Creek under a NJPDES Permit.

In June, 1985, RES installed 8 wells around the RCRA regulated units, basins B-206 and B-207, to satisfy Interim Status ground water monitoring requirements. Two wells (L1 and L2) were installed in June, 1986, to monitor the south side of the L series lagoons. These wells were all installed with PVC, are 4 inches in diameter, and are screened in the water table zone (between 0' and 20' below sea level). Drill logs indicate that the area is underlain by coarse to fine sand with some silt and clay lenses.

4. Ground Water Quality

a. General Overview

Soon after RES began operations in 1969, ground water contamination beneath the facility became evident. By the end of 1972, RES had installed 25 wells in the water table zone. Six of these wells were part of a pumping well system whose purpose was to intercept, pump, and decontaminate the ground water. Since October 1971, when the State first ordered RES to commence ground water decontamination activities, efforts have been made to monitor and control the extent of ground water contamination at the site. Early in the history of site investigations, RES determined that total dissolved solids (TDS) was a good indicator of ground water quality. Historically, RES has used TDS values below 500 mg/l to define background levels and values above 500 mg/l to represent contaminated ground water. Through the years, RES has used TDS along with several parameters (e.g. TOX, TOC) and specific inorganic constituents (e.g. Fe, Cd, Cr) to define the boundaries of ground water contamination.

In early 1982, a substantial amount of organic contamination was found as a result of a comprehensive waste characterization study. This was the first study in which specific organic contaminants were analyzed rather than broad parameters such as total organic carbon (TOC) and total halogenated carbon (TOX). These parameters continued to be used in ground water investigations, however, since RES contended that wells contaminated with specific organic constituents were all within the plume defined by the organic parameters and the 500 mg/l TDS boundary. Trace organic contamination was found during an investigation in 1984 and confirmed again in 1985 and 1986 in Well DP5 which penetrates the shallow artesian zone. Deep wells within the water table zone also show organic as well as inorganic contamination.

Background ground water quality data has been collected mostly from public water supply wells in the area as well as from the now sealed Main Production Well at the facility (Figure 6). Data from these wells supports the conclusion that ground water in the water table zone and shallow artesian zone has been affected by activity at the RES site. The range of TDS in uncontaminated ground water from the Upper Potomac-RaritanMagothy aquifer range from 30-200ppm (Parker *et al.*, 1964) while chloride concentrations in the lower reaches of the aquifer system (200-270 feet below sea level at the RES site) range from 250 mg/l to 27,000 mg/l (Walker, 1983). The lower reaches of the system are known to be slightly brackish in nature and the zone is not used for drinking water purposes.

b. Ground Water Quality and The RES Ground Water Monitoring Program

Background ground water quality in the area surrounding the RES site is good. Several drinking water supply and production wells in the region

—Minimum, median, and maximum values of physical characteristics and chemical constituents.
[Concentrations in milligrams per liter of dissolved constituent except as noted.]

Parameter	Number of samples	Minimum	Median	Maximum
Temperature (°C)	860	8.9	14.5	24.0
Specific Conductance, field (umhos)	668	39	350	5,820
Specific Conductance, lab (umhos)	1,600	32	307	6,000
pH, field (units)	452	3.9	6.7	8.9
pH, lab (units)	744	2.8	6.9	9.4
Alkalinity, field (as CaCO ₃)	421	0	75	1,580
Alkalinity, lab (as CaCO ₃)	382	0	54	315
Dissolved oxygen	137	0	0.3	10.4
Hardness (as CaCO ₃)	1,004	0	55	570
Hardness, noncarbonate (as CaCO ₃)	990	0	2	569
Sodium	951	1.4	12	1,000
Potassium	940	.1	4.1	100
Calcium	971	.1	15	160
Magnesium	967	.1	4.4	100
Sulfate	1,034	0	17	1,700
Chloride	2,359	.6	20	1,900
Fluoride	685	0	0.1	6.2
Silica	965	0	9.1	53
Nitrate nitrogen (as N)	365	0	0.18	18
Nitrate nitrogen (as NO ₃)	575	0	0.6	198
Ammonia nitrogen (as N)	147	<.01	0.25	25
Ammonia nitrogen (as NH ₃)	146	.01	0.32	32
Ammonia and organic nitrogen (as N)	147	<.1	0.5	28
Nitrate and nitrite nitrogen (as N)	394	0	0.1	18
Orthophosphate phosphorus (as P)	516	0	0.06	3.2
Iron, total (ug/L)	523	0	1000	171,000
Iron, dissolved (ug/L)	479	0	1000	460,000
Manganese, total (ug/L)	482	0	80	24,000
Manganese, dissolved (ug/L)	477	0	77	15,000
Aluminum (ug/L)	193	0	100	18,000
Arsenic (ug/L)	160	<1	<1	11
Barium (ug/L)	260	0	70	410
Beryllium (ug/L)	259	<.3	<1	8
Cadmium (ug/L)	276	0	2	120
Cobalt (ug/L)	275	0	<3	280
Copper (ug/L)	278	0	<10	930
Chromium (ug/L)	171	0	<10	880
Chromium, hexavalent (ug/L)	148	<1	<1	130
Lead (ug/L)	263	0	<10	47
Lithium (ug/L)	270	0	7	200
Molybdenum (ug/L)	257	.5	<10	60
Strontium (ug/L)	270	<1	325	4,400
Vanadium (ug/L)	257	2	<6	20
Zinc (ug/L)	282	0	12	1,700
Dissolved organic carbon	409	0	1.4	108
Dissolved solids (residue on evaporation at 180°C)	973	25	136	3,910
Dissolved solids (sum of constituents)	945	26	132	3,220

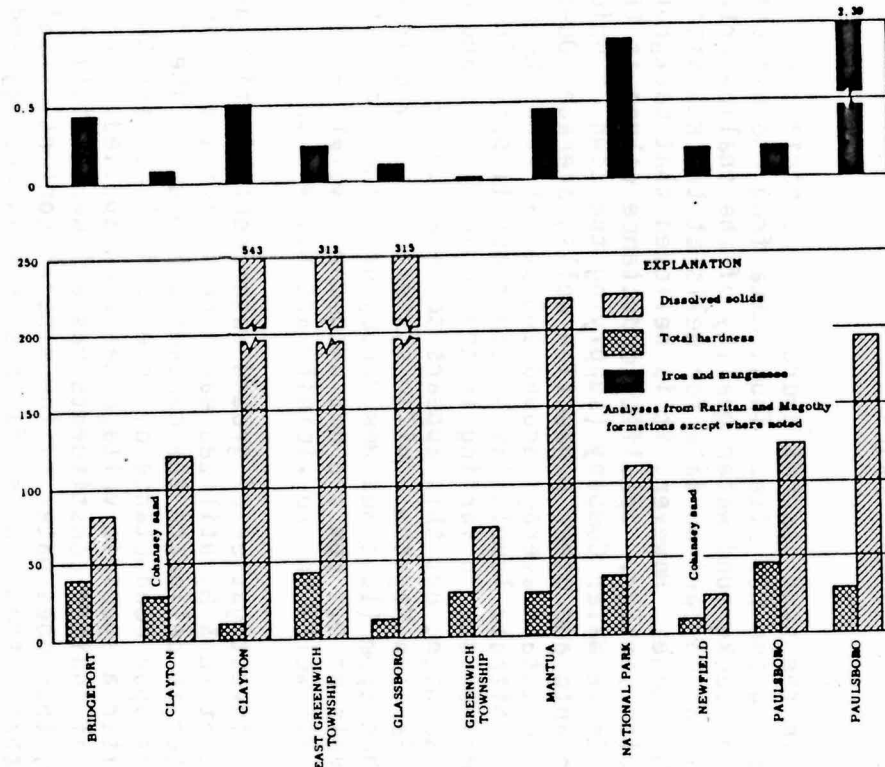


Figure 16. Water quality in southwestern New Jersey. From Hardt (1963) and Fusillo et al. (1984).

are screened in the same general hydrogeologic horizon as the shallow artesian wells on the RES site. Thus, data from the off-site wells are a good example of background water quality of the shallow artesian zone at RES. There is no comparison data for wells at the RES site screened in the water table zone. However, it is believed that background water quality is quite similar. Specific conductance values at the nearby (1-2 miles) Penns Grove Water Company (supplying the town of Bridgeport), Pureland, Monsanto and other production wells, average 100-500 micromhos. Dissolved solid totals average around 100 ppm at Penns Grove and other nearby wells. Nitrate levels (as N) can reach 11 ppm. These relatively high levels may be due to farming in the region. Iron and manganese levels are also high; but this appears to be a function of natural conditions in the Raritan-Magothy aquifer system. Dissolved iron concentrations of greater than 1ppm (10 times New Jersey drinking water standards) and manganese levels of 0.1 ppm are not uncommon. Volatile organic concentrations for all wells in the vicinity are below 1 ppb.

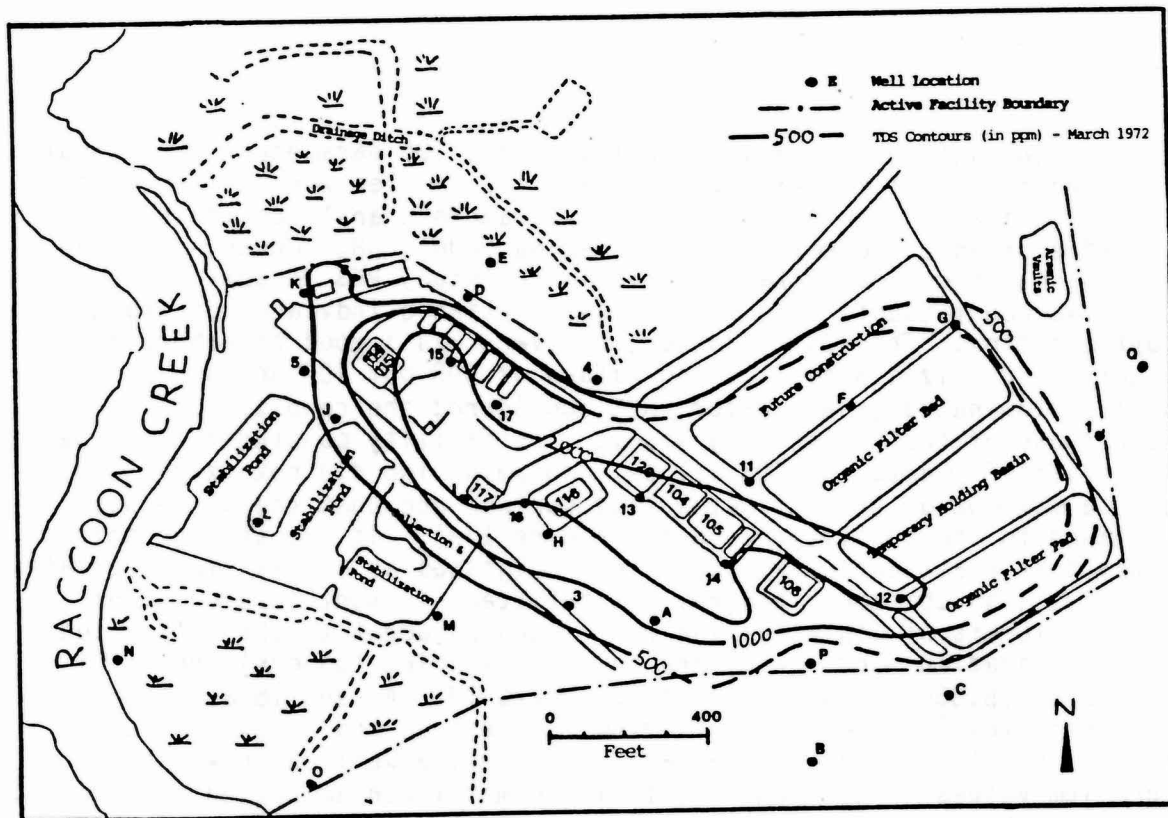
In RES' first investigation of ground water contamination during 1972, their consultant (G & M) utilized earth resistivity and chemical analysis of ground water to delineate the contaminant plume. The resistivity method depends upon conductance of an electrical current through the subsurface after a specific voltage has been applied. Ground water with a high level of ionized constituents has a lower resistivity (greater conductivity) than does water of low mineral content. RES' consultants determined, that although other factors such as geology and saturation may be important factors that affect resistivity, most of the resistivity contrasts can be attributed to the chemical quality of the ground water. Because these measurements are not dependent upon specific constituents, the results can be qualitatively related to TDS, a parameter which RES has used to track contamination for the past 15 years.

In the resistivity evaluation, a Wenner electrode configuration was used. This configuration requires four electrodes to be placed in the ground equidistant from each other and in a straight line. An electrical current is applied to the ground through the outer two electrodes and the potential drop across the inner electrodes is measured. By increasing the electrode spacing, the depth being examined is increased by an equal amount. 19 vertical profiles were made at the site, with each vertical profile consisting of 17 electrode spacings which increased from 3 to 51 feet in increments of 3 feet. RES also made 79 fixed depth measurements using an electrode spacing of 51 feet which RES decided was of sufficient depth to include possible contamination. RES' consultants determined that the results of the study were "conclusive enough to permit the delineation of a zone of highly mineralized ground water" at the site. Areas of highly mineralized ground water (high TDS) were inferred from resistivity levels below 400 to 600 ohm-feet. Groundwater beneath the center of the site showed resistivity levels as low as 100 ohm-feet. Based on RES' initial interpretation of the data, ground water quality was not affected beyond the immediate area of the facility and contamination did not extend deeper than a maximum of 28 feet below land surface.

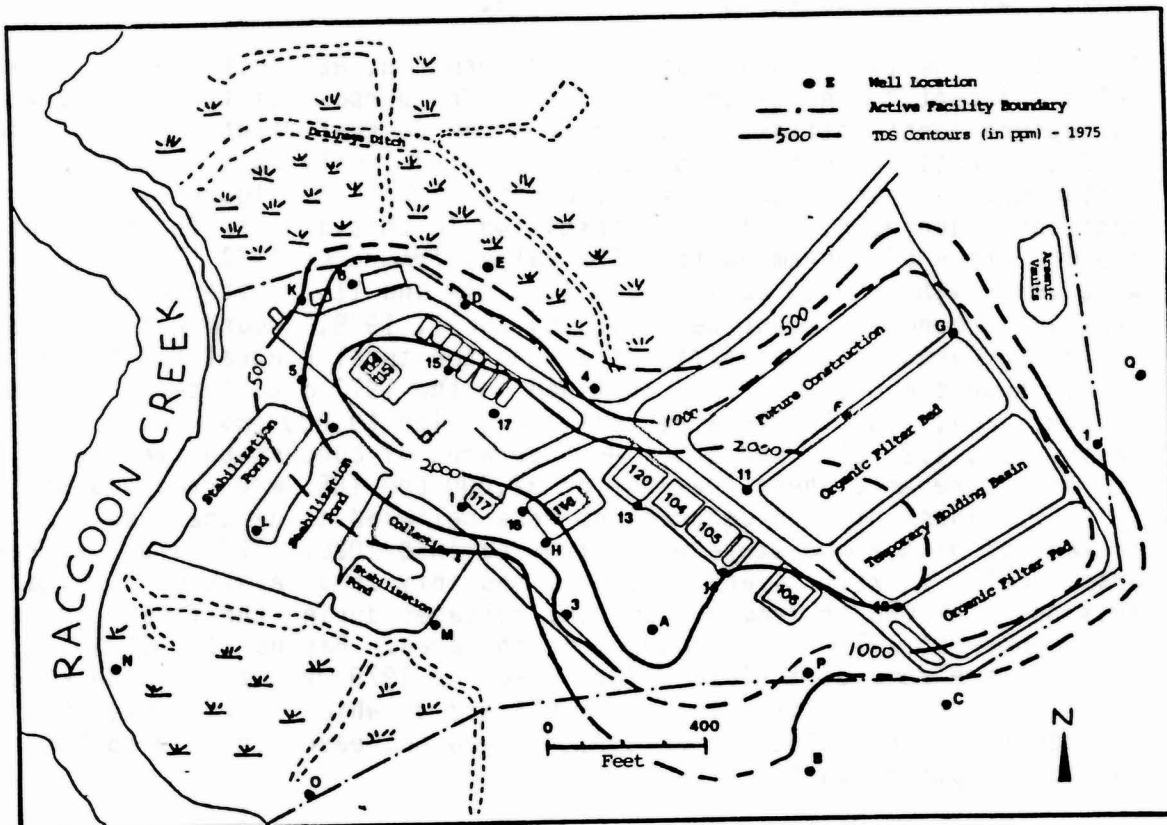
RES' consultants used chemical analyses (the TDS parameter in particular) as a verifier of the resistivity data. 100 samples were collected from 75 well points on the site. Chemical parameters analyzed included: TDS, volatile organics, chemical oxygen demand (COD), pH, copper, chromium, magnesium, zinc, and nickel. Early in the study RES determined that no specific constituent could be used as a reliable indicator of ground water contamination. The TDS parameter, however, was a good signature for highly mineralized water. Using values of 500 ppm TDS or more to represent contaminated ground water, RES considered the results consistent with those of the resistivity study. The facility concluded that, based on resistivity data and TDS values, contamination did not extend deeper than a maximum of 28 feet below land surface and that the plume was confined to the facility boundary (Figure 17a). It was through this study that abatement wells were first suggested as a possible remediation technique; an abatement program was initiated six months later. The highest levels of contamination were found adjacent to the collection and equalization ponds (what are now the L-series lagoons) where TDS values of 15,000 ppm were recorded. Wells 13, 14, and 15 all showed very high levels of copper, chromium, magnesium, and zinc. Copper levels in Well 13 were as high as 135 ppm while Well 15 showed total chromium values of 150 ppm. Most of the metal contamination was probably due to leakage from surface impoundments in the central area of the facility which are no longer in existence.

As part of the 1972 contamination study program, RES installed 6 abatement wells adjacent to the L-series lagoons. The purpose of these wells was to capture contamination emanating from the Central Plant Area. During a 1975 investigation high TDS level indicated localized spreading of contaminated ground water in the vicinity of Well 4 (Figure 17b). Four additional abatement wells were installed in this area to further control the migration of contaminants. TDS values from June 1977 (Figure 18a) were very high beneath Basins 111, 112, 114 and 115 in the Central Plant Area and around Abatement Well 21. By April, 1978, ground water contamination appeared to be significant around the total Central Plant Area rather than the specific area outlined in the 1977 data interpretation (Figure 18b). TDS levels were still very high (9,000 ppm) beneath Basins 111, 112, 114, and 115. Another area of concern became the Basin Closure Area where readings of 32,000 ppm TDS were recorded at Well EE. These high concentrations were believed to be the result of leakage of high temperature waste from basin B-202G. TDS values increased dramatically in Wells 4 and Y as well possibly as a result of leakage from basin B-202G or from contaminant releases during the fire/ explosion of December of 1977 which occurred in the area. Basins 111, 112, 114, and 115 were removed in late 1978. Based on 1979 results, ground water quality in this area improved. Wells 5 and J, which showed levels between 5,000 and 7,000 ppm in 1978, showed decreases in 1979 to 200 and to 300 ppm respectively.

(a)



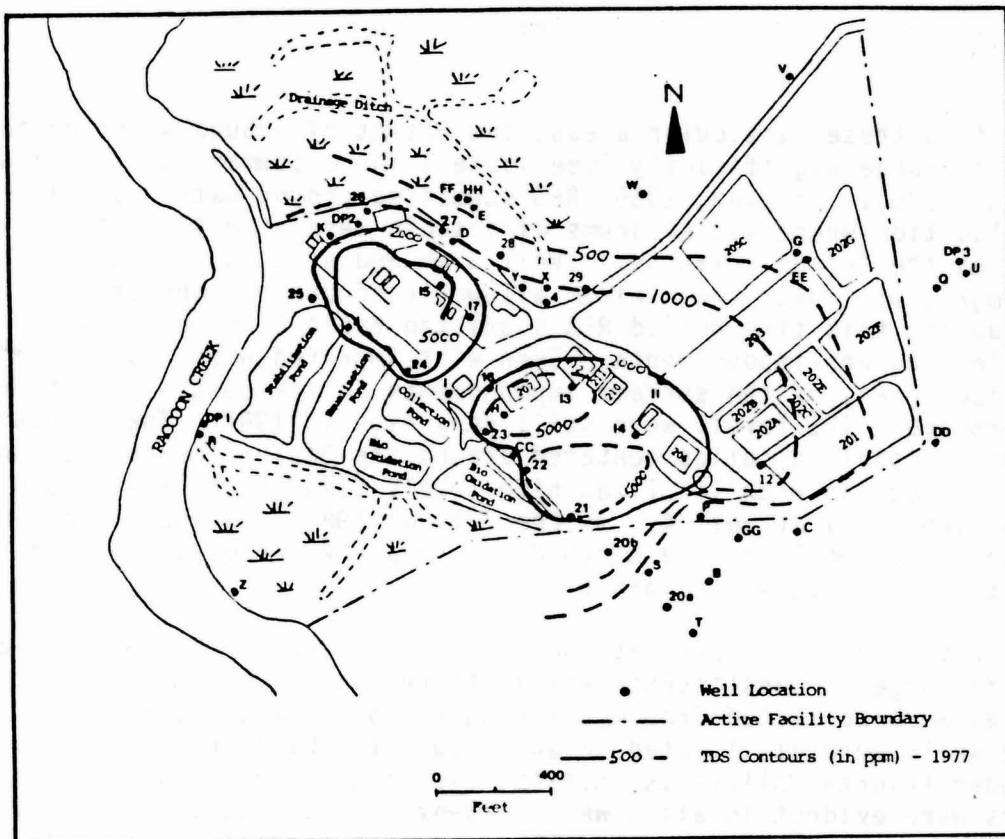
(b)



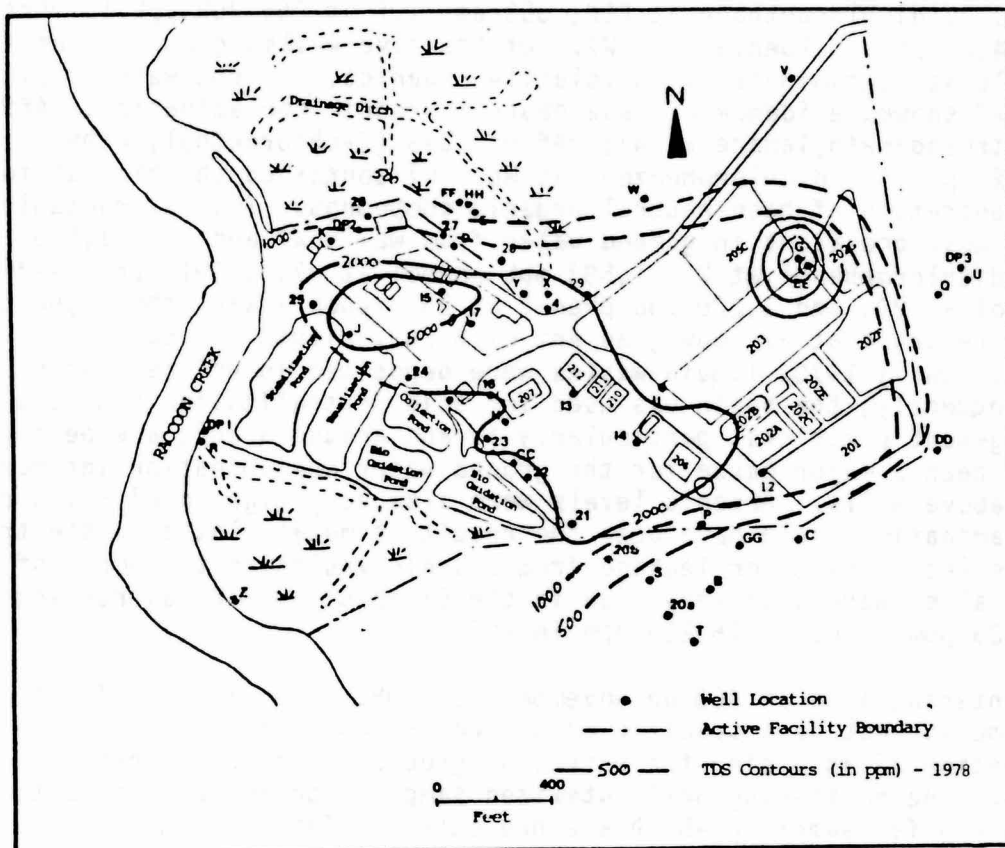
Rollins Environmental Services Facility Map - 1972

Figure 17. Total dissolved solids (TDS) contours at RES for (a) 1972 and (b) 1975.

(a)



(b)



Rollins Environmental Services Facility Map - 1980

Figure 18. Total dissolved solids (TDS) contours at RES for (a) 1977 and (b) 1978.

Other than these particular areas, the extent of ground water contamination did not change significantly (see Table 1 for a summary of TDS data through 1980). In June, 1980, RES submitted ground water data from south of a location where sealed drums of arsenic were stored between 1970-1974, known as the "arsenic vaults." Well G showed arsenic concentrations of 0.34 mg/l, well over the maximum allowable concentrations of 0.05 mg/l. Also during this time period RES submitted Basin Closure Plans for the B-series lagoons/impoundments. Even with improved waste management practices (many of the surface impoundments in the Central Plant Area were removed) TDS levels were still very high in 1981. The highest levels of total dissolved solids centered around the Basin Closure Area and the L-series lagoons with localized high levels (17,000 ppm TDS) found in the North Marsh Area at Well 4. In the fall of 1981, RES installed clusters of monitoring wells in the North Marsh Area (MA series); preliminary results did not show contamination.

The first study undertaken at the RES site to analyze the ground water for specific organic constituents was initiated in October, 1981. Ground water samples were collected from monitoring wells II, W6, W7, EE2 and 29. These wells were all located in and around the Basin Closure Area. Analyses included Priority Pollutants, metals, cyanide, and phenols. Volatile organics were evident in all 5 wells. Benzene, TCE, 1,2,-dichloroethane, toluene, and ethylbenzene were all present in significant quantities. High values included: 2,850 ppb benzene at W7; 1,930 ppb benzene at W6; 2,032 ppb 1,2,-dichloroethane at EE2; 353 ppb TCE at 29; 208 ppb toluene at II; and 408 ppb ethylbenzene at W7. Of the five wells, ground water from II was least contaminated with volatile organics. Ground water from W6, 29 and W7 showed evidence of base neutral organic contamination: 469 ppb N-nitrosodimethylamine at W7; 246 ppb bis (2-chloroethyl) ether at 29; and 22 ppb 1,2-dichlorobenzene at W6. W7 contained the highest total concentration of base-neutral organic compounds. Acid extractable compounds were most prevalent in ground water from wells W7 and 29: 1,925 ppb 2,4-dichlorophenol at W7; 1,593 ppb phenol at W7; 1,191 ppb 2,4-dimethylphenol at 29; and 1,220 ppb phenol at 29. Once again, the highest values were recorded at W7, downgradient of B-202, within the Basin Closure Area. Until 1970, liquid wastes were deposited in unlined basin B-202. Subsequently, the basin was used for acid neutralization sludges. Waste management practices, particularly in and around B-202, are believed to have been a major cause for the ground water contamination intercepted by the above wells. Arsenic levels were also very high in W7 (2.05 ppm). Contamination could have been the result of metal plating waste treatment processes in B-202 or leakage from arsenic vaults to the north of B202. TDS values were also very high in the Basin Closure Area, ranging from 10,529 ppm in W6 to 16,219 ppm in EE2.

By entering into an ACO on November 23, 1981, RES, for the first time, became subject to a specific ground water monitoring program with the intention of assessing the extent of ground water contamination at the site. The monitoring wells utilized sampling parameters and a time schedule for sampling which are presented in Table 2. Unfortunately,

TDS CONCENTRATIONS AT RES, 1972-1980 (ppm)

Well	March ¹ 1972	1976 ¹	1977 ²	April 1978	March 1979	1980 ³
1	245					
3	365	1,000				
4	200	575	1,378	3,315	2,417	8,376
5	150		9,096	9,596	239	
6	150	1,100				
11	1,350	4,500	2,246	1,950		
12	5,100	2,500	1,396	1,482		
13	2,700	5,000	12,181	2,115	511	475
14	1,800	1,500	3,911	3,522	2,732	2,042
15	5,000	15,000	25,397	9,116	26,310	5,610
16	1,400	1,500	1,000	1,987		2,380
17	1,000	3,700	3,532	2,369	1,922	6,033
B	135	234	79	197		179
C	147	496	247	392		210
E			70			
F	1,583					
G	1,022					
H	1,324	1,578	1,620			
I	2,700	1,792				
J	775	1,924	4,564	6,106		
K	535	487	1,050	1,529		
P	448	733	214	257		362
Q	52	266	130			
20	300	500				
21	2,500	3,200	15,662	4,543	2,791	5,827
22	1,500	700	16,804	525	1,293	1,947
23	1,000	1,595	5,986	3,831	2,351	2,232
24	730	2,500	5,565	3,655	1,502	4,207
25	235	500	4,919		1,145	4,080
R			617	325	324	754
S			266	222		
T			264	268	283	250
U			109	102	130	111
V			100	129	144	124
W			255	197	166	265
Z					466	
20A			2,917	356	1,041	640
20B			1,456	826	237	1,340
26			921	719	2,177	1,097
27			3,360	857	1,511	1,093
28						2,460
29						3,303
EE					31,562	15,350
HH					164	261
AA					447	
DD					579	268
II						1,095

1. Values are average from samples taken during 1975 and January, 1976.
2. Values are from samples taken in January, February, and March.
3. Values are averages from samples taken during 1980.

Table 1

(A)

SAMPLING WELLS AND PARAMETERS AT RES - 1981 ACO

<u>Wells Sampled Quarterly</u>		<u>Wells Sampled Yearly</u>		<u>Wells Sampled Quarterly for PCBs</u>	<u>Wells Sampled Quarterly for Arsenic</u>
20b	28	DP1	R		
21	29	DP2	U	14	29 W12
22	4	DP3	W	21	EE1 W17
23	EE3	DP4	CC	22	EE2 AV-1
24	HH	DP5	DD	322-2	II AV-2
25		11	EE1		4 AV-3
26		12	EE2		11 AV-4
27		13	II		12 DP3
		14	MW1		W11
		B	MW3		
		C	MW5		
		P4			
<u>Parameters</u>		<u>Parameters</u>			
TDS		TDS	Cd		
TOC		TOC	Cr		
pH		pH	Cu		
TOX		TOX	Zn		
		As	Pb		
		Phenols			
		NO ₃ -N			

(B)

SAMPLING WELLS AND PARAMETERS AT RES - 1983 ACO (unsigned)

<u>Wells Sampled Quarterly</u>		<u>Wells Sampled Yearly</u>		<u>Wells Sampled Quarterly for PCBs</u>
20b	25	DP1	P4	
21-a	4	DP2	R	14
22	HH	DP3	U	21-a
23	35	DP4	W	22
24		DP5	CC	322-2
30S and D		13	DD	
31S and D		14	11	
32S and D		B	MW5	
33S and D		C	W21	
34S and D		MW1	W23	
		MW3		
		MA6S,I,D		
		MA10S,I,D		
		MA11S,I,D		
<u>Parameters</u>		<u>Parameters</u>		
TDS		TDS	Cd	
TOC		TOC	Cr	
pH		pH	Cu	
TOX		TOX	Zn	
		As		
		Phenols		
		NO ₃ -N		

Table 2

the Order did not specify provisions to sample wells for organic constituents besides the broad based indicators - TOC and TOX. The Order did, however, require that 15 wells be sampled quarterly and 17 annually for arsenic. Five wells screened in the shallow artesian zone were in place by this time and were part of the monitoring program. By March, 1982, RES was operating with both the 30-series and 20-series abatement wells. The older 20-series system is adjacent to the L-series lagoons and the 30-series wells (screened in both shallow and deeper levels of the water table zone) intercept contaminated ground water from the Basin Closure Area and North Marsh Area.

Results based on the new monitoring program through 1983 were not significantly different than results up to that time. For the first time, however, arsenic analyses were being performed over a wide area. Arsenic contamination was most prevalent in the Basin Closure Area and the North Marsh Area. The highest recorded arsenic values were from EE3, near B-202, and the arsenic vaults which showed concentrations in 1982 of 1.02 ppm, 20 times the drinking water standard of 0.05 ppm. Other values in the Basin Closure Area included: 0.13 ppm at W12, 0.69 ppm at EE2, 0.18 ppm at AV1 and 0.13 ppm at AV3a. In the North Marsh Area, downgradient of the Basin Closure Area, values were: 0.50 ppm at MA10I, 0.85 ppm at 31D, 0.35 ppm at 33D, and 0.49 ppm at 29. While it cannot be certain whether arsenic contamination is a result of leakage specifically from the arsenic vaults, it appears reasonably certain that contamination is from the Basin Closure Area in general. Closure of the basin area, which includes all B-series impoundments, began in 1982 and was completed in 1986, prior to the Task Force Inspection.

TOX values, a broad indicator of organic contamination, were relatively high in the North Marsh Area in 1982, especially around Well 4a where levels reached 33.3 ppm. Maximum allowable ground water concentrations for TOX are 0.05 ppm. High levels were also found in Wells 29, MW5 and HH. Unfortunately RES used (and still uses) sampling methods whose detection limits are above drinking water standards; thus a true picture of organic contamination is not available. The same is true for lead. The detection limit of 0.2 ppm is well above the drinking water standard of 0.05 ppm. Even so, elevated levels of lead were found in the North Marsh Area (1.4 ppm at MA10S) at up to 20 times the drinking water standard. Elevated levels of chromium and copper were also found in the North Marsh Area during the 1982 studies. Chromium contamination was most prevalent at Wells MA10S, I, and MA11S where values of up to 1.46 ppm were recorded. Minor copper contamination also exists in the North Marsh Area; values of 1.10 ppm and 1.04 ppm were recorded at Wells MA10I and 31S respectively.

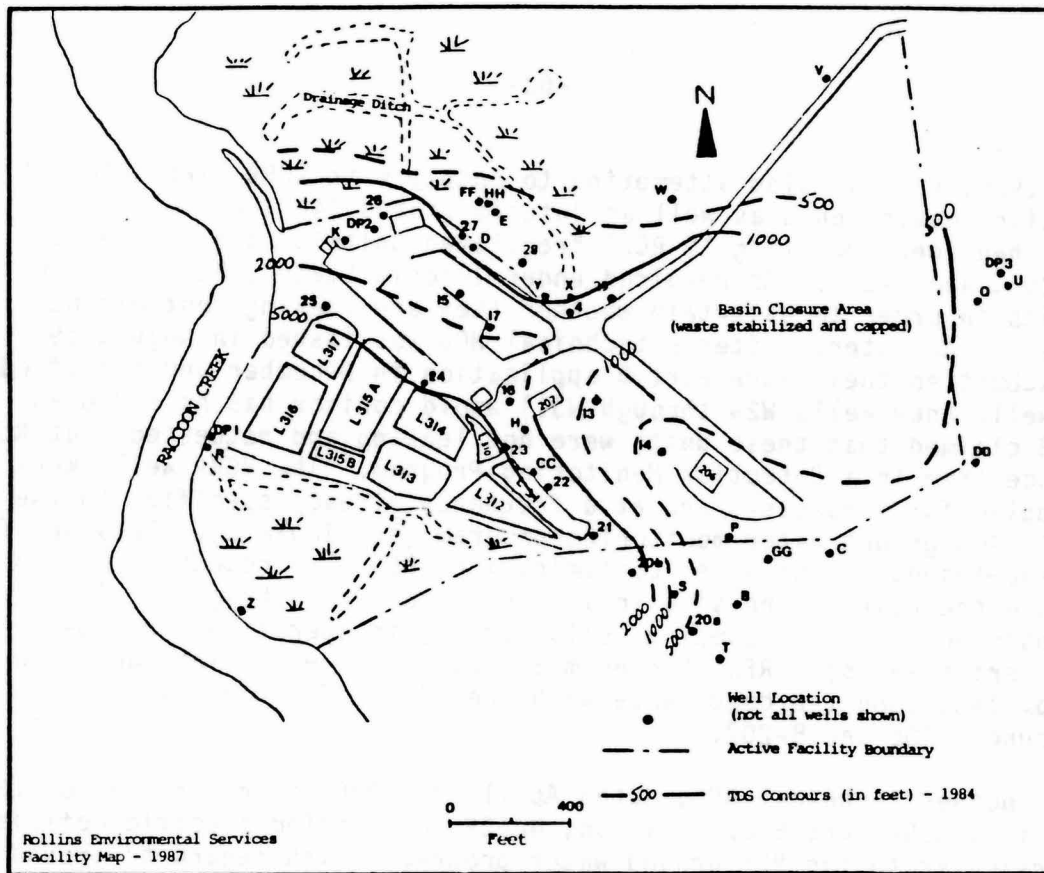
A revised ACO was issued in August, 1983. Although the ACO was never signed, RES adhered to its ground water monitoring program (Table 2). It differed from the 1981 program in that many of the wells in the original sampling program, because of basin closure, were replaced by wells in the North Marsh Area (the MA-series and 30-series wells). Also, in the 1983 Order, quarterly analyses for arsenic were no longer required.

Arsenic remained a parameter for yearly sampling, however. This monitoring program did not change appreciably through 1985. Annual surveys for both 1984 and 1985 concluded that the "extent of contamination in the water table zone (remains) virtually unchanged."

In 1984 the 500 mg/l TDS contour, which RES has used to define ground water contamination, moved northward into the North Marsh Area, possibly as a result of pumpage from the 30-series wells. Otherwise, TDS levels did not change significantly (Figure 19a). As in 1981-1983, TOX detection limits were above drinking water standards; thus, this indicator did not adequately delineate organic contamination. TOX levels greater than 1 mg/l were found in Wells 20B, 4a, 24 and 25 (1.2 ppm., 4.9 ppm, 2.6 ppm, and 1.3 ppm respectively, were detected). These high values appeared in both the North Marsh Area and along the northern boundary of the L-series lagoons. Phenol, chromium and arsenic contamination was confined to the same area cited above. Arsenic levels of 0.12 ppm and 0.10 ppm were detected in Wells 34S and MW1a respectively, and 2.50 ppm chromium was detected at 30S. High cadmium levels were recorded in wells adjacent to the L-series lagoons. It is important to note that both inorganic (metals, TDS) and organic (TOC, TOX) parameters indicated that contamination was present in the deeper ground water zones of the North Marsh Area, at levels 40-70 feet below land surface. RES' consultants interpreted this zone to be deeper portion of the water table zone. In 1984, the shallow artesian zone wells (DP1-5) continued to yield uncontaminated ground water with TDS levels averaging under 200 ppm.

The ground water monitoring program did not change during 1985 and conclusions regarding ground water contamination remained essentially the same. TDS distribution remained constant. Very high concentrations continued to be detected adjacent to the L-series lagoons. Because basin closure (B-series Basins) included the removal of all wells in the area, ground water quality beneath this area could not be determined. Levels of inorganic and organic contamination remained close to levels observed in 1984. Unfortunately, the analytical detection limit for arsenic increased from 0.10 to 0.1, above drinking water standards. Therefore, values attained in 1985 are not meaningful. For the first time, ground water from one of the shallow artesian wells (DP5), showed minor amounts of 1,2dichloroethane and trichloroethylene contamination. After resampling, these results were shown to be representative of ground water conditions. Ground water from other deep wells continued to be of good quality. RES' consultants conducted an electrical earth resistivity survey as required by the 1981 ACO. RES concluded that the results confirmed those of the ground water study. Multiple depth measurements were made by varying electrode spacing from 20 to 100 feet, in 20 foot increments. It is interesting to note that even at a 100 foot spacing (which describes resistivity at a depth of 100 feet), very low resistivity measurements were recorded (40 to 100 Ohm/feet) implying highly mineralized ground water at depth.

(a)



(b)

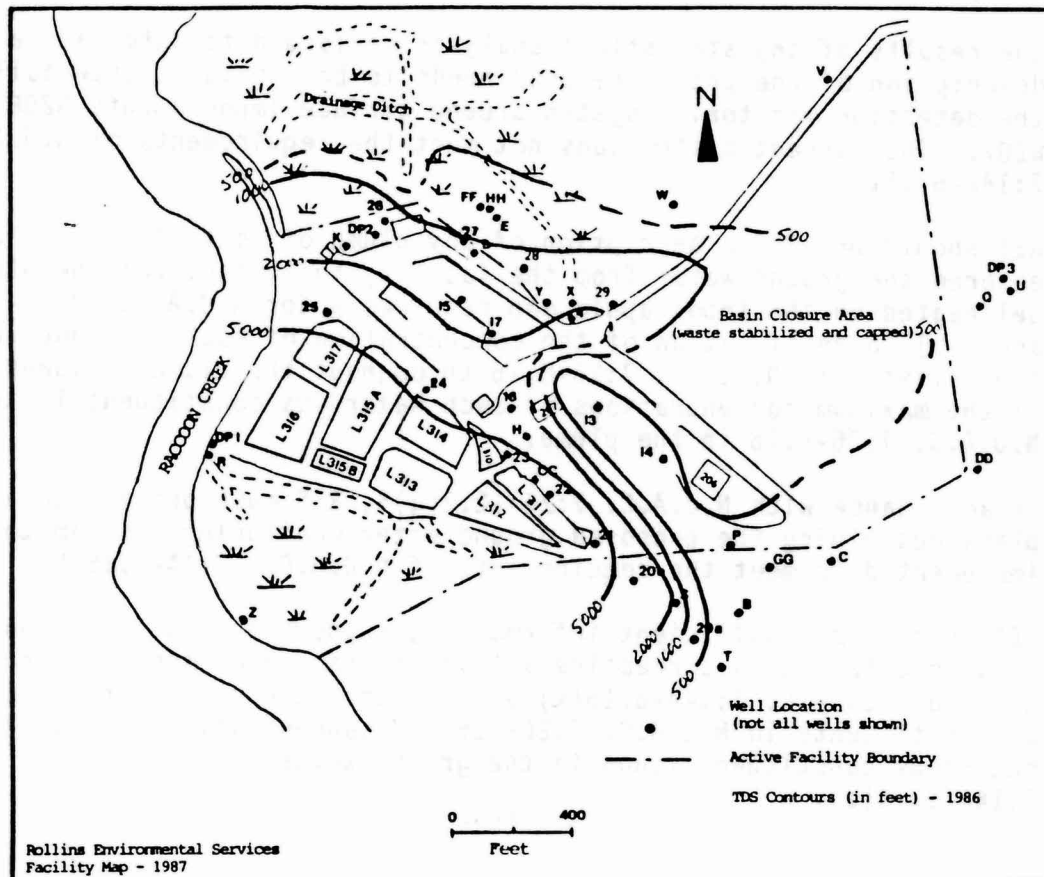


Figure 19. Total dissolved solids (TDS) contours at RES for (a) 1984 and (b) 1986.

In 1985, RES was also attempting to comply with RCRA Part B Permit application requirements as well as Interim Status (40 CFR 265) regulations. RES had been operating 10 RCRA "regulated units": the 8 L-series lagoons, B-206, and B-207. As required under Interim Status, RES must monitor these units in order to ascertain whether they are leaking contaminants into the ground water. After a technical NOD was issued in August 1985, RES resubmitted their RCRA Part B application in December and specified that 8 wells (new wells W24 through W31) would monitor basins B-206 and B-207. RES claimed that these units were not leaking and requested that NJDEP place them in a Detection Monitoring Program. The RCRA wells were to be sampled for parameters and at a frequency already specified in the unsigned 1983 ACO ground water monitoring program (see Table 2). Because of acknowledged ground water contamination, RES also requested that NJDEP place the rest of the site in a Corrective Action Program. This program consisted of the 17 pumping wells already in operation (the 30-series and 20-series wells). RES' "Interim Status" wells would include those sampled from 1983-1985 (in compliance with the 1983 ACO) along with wells W24-31 around B-206 and B-207.

In another technical NOD, dated April 17, 1986, in reference to RES' revised RCRA Part B application, NJDEP identified specific deficiencies particular to the RES ground water program. With regard to ground water quality, some of these deficiencies included:

- 1) the results of any statistical analysis performed to date, and a description of the procedure used needs to be provided, especially for the detection monitoring system around surface impoundments B206 and B207. The current system does not meet the requirements of N.J.A.C. 7:14A-6.15.
- 2) RES should provide a description of any plume of contamination that has entered the ground water from the facility including: (a) the plume delineated on the topographic map required under N.J.A.C. 7:26-12.2(e)13 and, (b) identification of the concentration of each hazardous constituent listed in N.J.A.C. 7:26-8.16 throughout the plume or identification of the maximum concentrations of each hazardous constituent listed in N.J.A.C. 7:26-8.16 in the plume.
- 3) In accordance with N.J.A.C. 7:26-12.2(g)5, RES must provide detailed plans describing the proposed ground water monitoring program to be implemented to meet the requirements of N.J.A.C. 7:14-6.15(h).
- 4) RES must submit sufficient information, supporting data, and analyses used to establish a corrective action program which meets the requirements of N.J.A.C. 7:14A-6.15(k) and includes the extent and concentrations of constituents in N.J.A.C. 7:26-8.16 and concentration limits for each hazardous constituent found in the ground water as set forth in N.J.A.C. 7:14A-6.15(e).

The facility realized that, because the entire site was contaminated and B-206 and B-207 were downgradient of the contaminated areas and because B-206 and B-207 contain the same contaminants as does the ground water flowing beneath it, statistical analysis of upgradient and downgradient wells would not be able to show whether or not the basins were leaking as required by a Detection Monitoring Program. For this reason RES decided to proceed as if the basins were leaking contaminants into the ground water and include them in a State Corrective Action Program for the entire site.

RES admitted that it did not have enough data to delineate the contaminant plume with respect to all constituents found in the ground water. It did, however, propose a new monitoring plan which would take into account specific organic constituents. Based on TDS data already submitted, RES gave a general estimate of plume size: 2,300 feet long, 1,400 feet wide and 25 feet thick. RES contended that based upon analyses following the new monitoring plan, the facility would be able to delineate the plume for specific parameters and be able to change the abatement system accordingly. A significant portion of the NOD dealt with RES' interpretation of the local hydrogeologic regime, an interpretation which NJDEP believed to be inadequate. RES' response was essentially a summary of much of the information discussed in the preceding Section 3 on Site Hydrogeology. A critical analysis of RES interpretations of hydrogeologic data and historical ground water quality data will follow in Section 5.

Because NJDEP never gave a formal response to the new monitoring plan proposed by RES, the facility continued the monitoring plan as specified in the unsigned 1983 ACO (with the addition of Wells W24-31). In the summer of 1986, EPA sampled 9 wells at the facility. All samples were collected in accordance with EPA, Region II protocol, and all samples were split with RES personnel. Results of total metal analyses indicated that arsenic and chromium contamination continued to be a problem at the site. Four of the 9 wells showed contaminant concentrations above drinking water standards (0.14 ppm at Well 31D and 21 ppm Cr at Well 15). Zinc, lead, and copper contamination was found in isolated areas. Results of organic analyses (volatiles and non-volatiles) indicated substantial organic contamination in Wells 4A, 15, 31D, 31S, II and 24. Approximately 30 organic compounds were detected. The highest values of organic contaminants were detected in Well 4A, an area of known organic contamination. Results from Well 4A included: 18 ppm toluene, 7.7 ppm TCE, 5.1 ppm naphthalene, and 1.2 ppm ethylbenzene. While this was not meant to be comprehensive plume analysis, it did show the need for much more rigorous sampling and essentially confirmed EPA results.

Prior to the Task Force Investigation, RES submitted its 1986 Annual Ground Water Report. As mentioned above, sampling locations and parameters had not changed significantly from preceding years. Interpretations were also similar to those of the previous 4 years. The report concluded that

ground water contamination remains, for the most part, confined to the site and can be defined by the 500 mg/l TDS contour (see Figure 19b). Exceptions include Wells R and AV2 which show some organic contamination. In the 1986 data analysis, detection limits were lowered for arsenic and lead to below drink water standards, thereby making the data more meaningful and conclusive. results were similar to those of the EPA study from the previous summer.

Chromium contamination continues to be evident in the North Marsh Area (although levels exceeding drinking water standards have been observed in the Central Plant Area as well - as seen in Wells 14 [0.07 ppm] and MW3a [0.05 ppm]). Organic contamination was again detected in shallow artesian well DP5. RES recommended that DP5 be sampled for VOCs on a quarterly basis to determine the concentration for these compounds. Twenty-one ground water samples were taken as part of the Ground Water Task Force and analyzed for the full "Appendix IX" sampling suite. Results are presented in another section.

5. Discussion

Rollins Environmental Services (RES) began operation in 1969; soon after, the facility documented ground water contamination beneath the plant site. The first ground water assessment study was submitted in early 1972. Using Total Dissolved Solids (TDS) as an indicator of contamination, RES and their consultants, Geraghty and Miller, continued through the next 10 years to monitor what they considered the contaminant plume and to abate the spreading of contaminants by installing pumping wells on the site. In November of 1981, RES and NJDEP entered into a Consent Agreement whereby RES would institute a more formal plan to describe site hydrogeology and assess ground water contamination. Specific organics were first detected in the ground water beneath the RES site as a result of a study conducted in early 1982. These findings were confirmed in subsequent analyses performed in 1985, 1986, and most recently, during the 1987 Ground Water Task Force Investigation. RES, however, still uses TDS as the parameter to define the boundary of ground water contamination. The facility has been submitting annual reports for the last 5 years which describe the progress of the contamination abatement program. According to RES, the contaminant plume, as defined by TDS, continues to remain confined to the facility boundary. RES concludes that the extent of ground water contamination remains virtually unchanged since 1983 and maintains that their ground water pumping system (which has also remained the same since 1983) is "effectively limiting contaminated ground water to the site."

There are currently 123 ground water monitoring wells in or around the perimeter of the RES site. 81 of these wells are either currently used in a monitoring program or have been used for periodic sampling within the last few years. The number of wells whose integrity has been maintained through the years and whose construction quality and maintenance can insure precise and accurate sampling results is significantly lower. Much of the work concerning hydrogeology, plume assessment, and ground water contamination abatement at the RES site has been produced as a result of the 1972 study and the studies submitted in 1981-1982 as part of the 1981 ACO requirements.

The April 1972 study, RES' first attempt to characterize site hydrogeology and define the extent of contamination, became the basis and reference report for subsequent work. As mentioned in the previous chapter, the study consisted of an earth resistivity survey and the installation of monitoring wells in the water table aquifer. Test drilling was carried out simultaneously with the resistivity survey to provide the control necessary to substantiate the validity of the method. Apparent earth resistivity is controlled primarily by the types of sediments in the subsurface, the degree of saturation of the sediments, and the concentration of conducting ions within the ground water. Thus, an understanding of the subsurface is extremely important, especially at a site such as RES where

the underlying stratigraphy is quite complex. RES used curves of apparent resistivity versus depth and cumulative resistivity versus depth to interpret the data. 600 to 800 Ohm-feet was used as a cutoff value to indicate zones of possibly high levels of mineralized waters (with readings below 600 Ohm-feet signifying possible ground water contamination). Through this program, RES concluded that contamination did not extend beyond the facility boundary and did not exist deeper "than a maximum of 28 feet below land surface." However, upon review of the vertical resistivity profiles, these conclusions are not readily apparent. Final conclusions were reached by interpreting cumulative resistivity curves instead of the 600 to 800 Ohm-feet cutoff values. A series of straight lines were drawn through points in the profiles. Changes in slope represented change in geology or ground water quality. For example, a decrease in slope may signify a decrease in ground water quality.

Examples presented in Figure 20 a,b,c show the highly subjective nature of these interpretations. In Profile RP5, RES' consultants highlighted a decrease in slope within 10 feet of land surface and determined it to signify a zone of highly mineralized ground water. However, one could draw a straight line through the whole set of points and interpret there to be contamination to a depth of 48 feet below land surface; apparent resistivities below 600 ohm-feet are through the entire vertical sequence. In RP6, resistivity decreases down to a depth of 51 feet. RES, however, concluded that, based on its interpretation of cumulative resistivity, contamination was only evident between depths of 9 and 27 feet below land surface. All resistivity readings in RP7 show low levels through a depth of 51 feet. By plotting slope changes in cumulative resistivities, RES' consultants concluded that contamination was only present between 3 and 21 feet below land surface. This interpretation, again, is highly subjective. Theoretical methods of interpretation such as curve matching might have aided in the study. With the help of geologic logs, field data could be plotted and compared with master curves developed for a number of resistivity layers with defined ratios of resistivity and thickness. With more control on geology, a negative resistivity departure method could have been used to correct the data and provide more meaningful interpretations.

17 wells were installed as part of the 1972 study. Based on the drill logs from these wells, 2 geologic cross-sections were developed (Figure 21a). According to RES interpretations, a "more or less continuous" clay zone exists beneath the tract and that the top of this clay ranges from +3 to -18 feet in elevation. Upon review of the logs, the interpretation of a continuous clay layer appears unsubstantiated. There are clay lenses throughout the site; however, they do not appear to be laterally continuous. Several of the logs show sand to sand with some clay through entire borings (Wells D, F, and P). Temporary well screens were set at various depths in several wells to obtain vertical profiles of total dissolved solids (TDS) (Figure 21b). Of the 16 wells that were profiled,

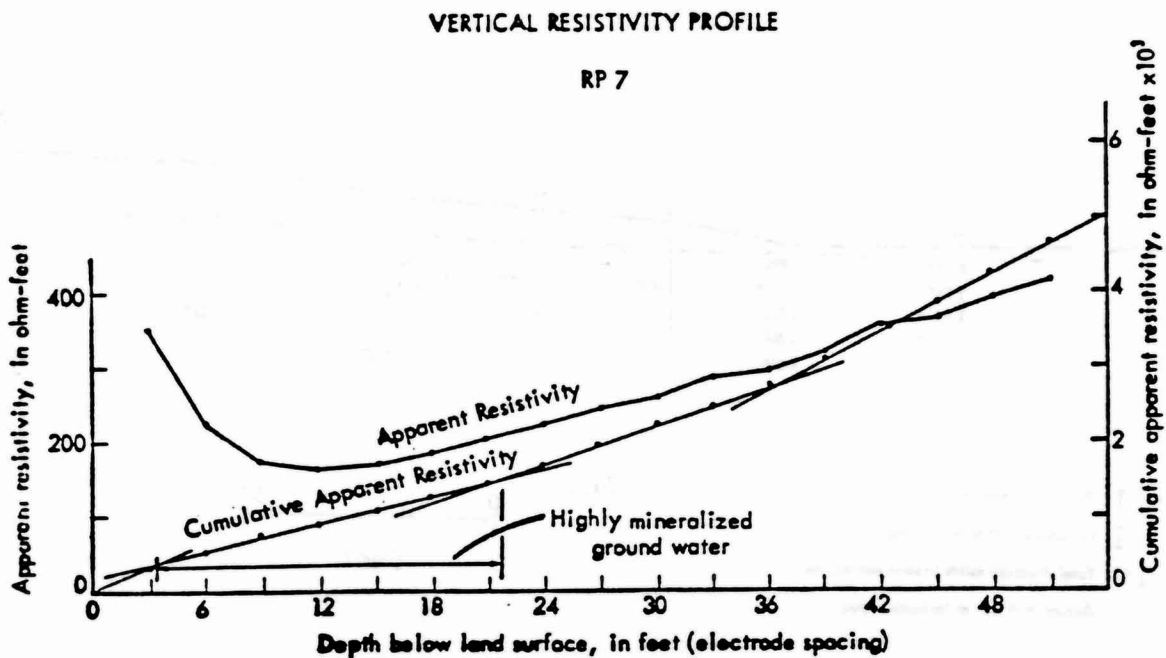
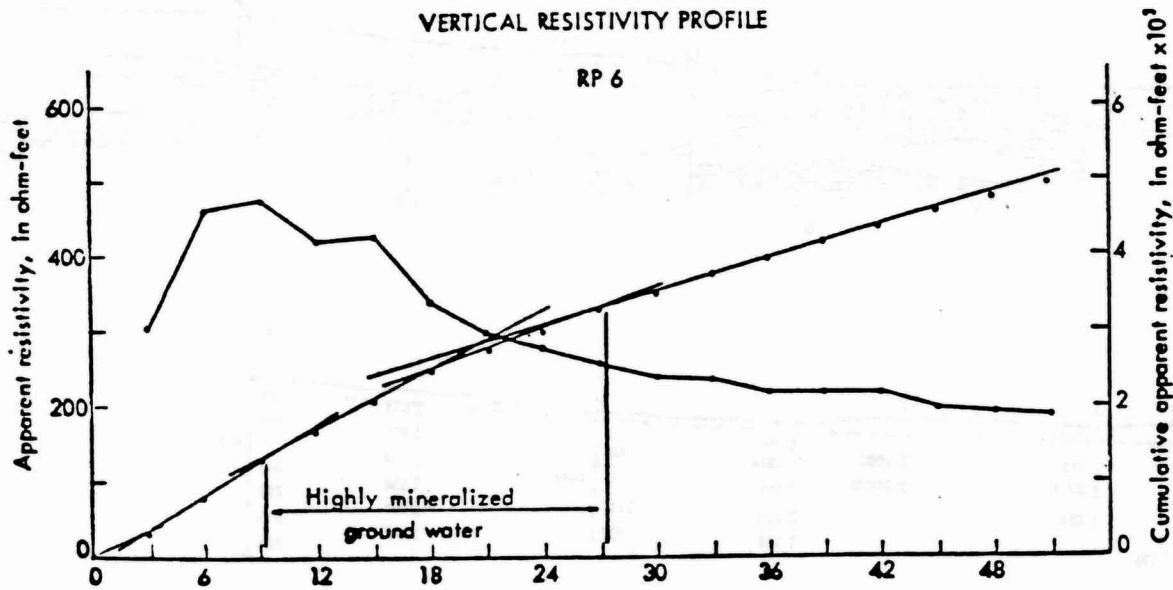
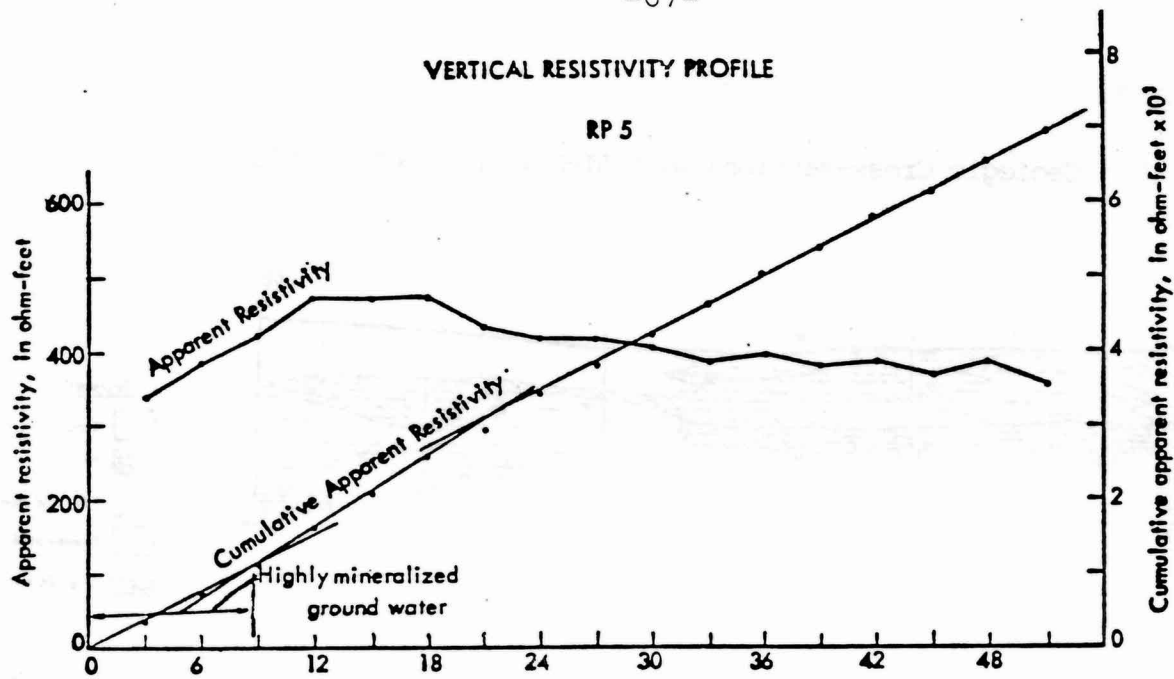


Figure 20. Vertical resistivity profiles for selected locations at RES. From Geraghty and Miller (1972).

Geologic Cross-sections with TDS Data at RES - 1972

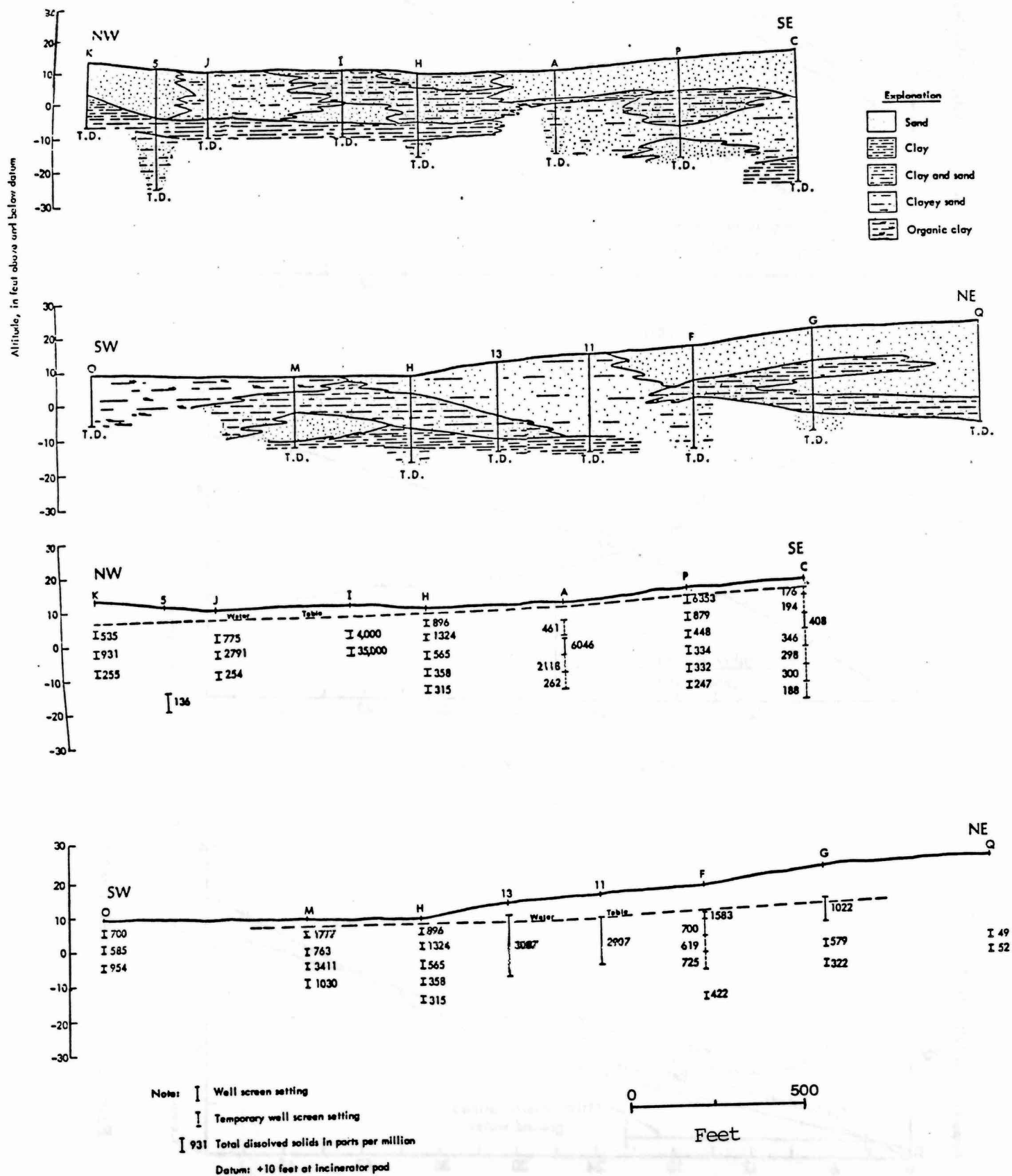


Figure 21. Geologic cross-sections with total dissolved solids (TDS) data at RES. From Geraghty & Miller (1972).

11 of them showed a decrease in TDS below 500 ppm 10 to 20 feet below land surface. However, for several wells near unlined surface impoundments, TDS levels remained well above 500 ppm below depths of 20 feet.

RES determined that the ground water discharge from the facility boundary to Raccoon Creek was on the order of 5,000 gallons per day. While the cross-sectional area and hydraulic gradient (2,000 ft and .0025 respectively) are reasonable values, the estimated hydraulic conductivity and unit thickness may be inaccurate. Because of the thick clay layers adjacent to Raccoon Creek, RES assumed a low permeability of 100 gpd/ft². There are, however, areas adjacent to the creek where permeabilities are probably substantially higher. Logs of Wells 25, MW7, K, and DP2, all adjacent to Raccoon Creek, show thick sand layers. Hydraulic conductivity values at some shallow wells are greater than 1,000 gpd/ft². Another parameter, the average thickness of the shallow deposits affected by contamination, which RES calculated as 10 feet, is also quite conservative. The thickness, based on the data in the 1972 report, is at least 20 feet in many areas, and from later data from the North Marsh Area, the thickness of contaminated sediment may be as high as 40 to 70 feet. Discharge to Raccoon Creek may be over 100,000 gpd from the water table aquifer.

The RES abatement system improved through the 1970's as more wells were installed and pumpage rates were increased. Major changes to the monitoring program occurred as a result of the November, 1981, ACO. A shallow artesian zone well test carried out in October, 1981, was designed to characterize the hydrologic properties of the shallow artesian zone and the degree of connection to the water table zone. The results of this test are presented in Chapter 3. Generally, water table wells to the south of DP4 (the shallow artesian well which was pumped) showed some drawdown while those to the southeast did not. The test was run primarily for qualitative purposes; the conclusion that there is a hydraulic connection between aquifers in the Basin Closure Area is a valid one. Unfortunately this type of test was not run in the Central Plant Area where most of the contamination problems exist. However, an inherent problem in running this test in a contaminated area is drawing down contaminated ground water into an uncontaminated aquifer. Background water level readings were not taken in some wells; because of the low drawdown in these wells, spurious conclusions may have been reached. Results from the EE series wells, 30 feet from the pumping well and screened at different levels in the water table zone, are excellent evidence of the connection between the two aquifers. EE2 (screened at 26-30 feet) and EE3 (screened at 33-39 feet) showed close to a foot of drawdown. Drawdown was observed only 10 minutes after pumping of DP3 began. This is a very quick response and a very large drawdown in a zone which RES contends is separated from the shallow artesian zone by 7 feet of low permeability clay. In the area of the EE series wells, the aquifer acts almost unconfined from the "water table zone" through the "shallow artesian zone." The well log of DP3, however, shows 6-8 feet of "stiff" clay at 48 to 56 feet below land

surface. If this clay layer is continuous in the southern part of the facility, it may explain why water table wells in that area do not show appreciable drawdown. The well test should have proceeded for more than 29 hours to determine delayed yield effects.

The quantitative results of the well test are tenuous. The transmissivity (90,000 gpd/ft) and storage coefficient (4.6×10^{-4}) were derived from leaky artesian type-curves. However, it is not certain what assumptions were considered in using the curves. DP4 is a partially penetrating well; this characteristic might have affected the results if not taken into consideration. The aquifer characteristics are probably more complex than those assumed using simple leaky artesian type-curves. Well logs do not support a 7 foot confining layer of any lateral continuity. The aquifer thickness is derived from one well log, that of the sealed Main Production Well. According to the abbreviated geologic log of the Main Production Well, a sandy/gravel unit, presumably the shallow artesian zone, exists between 36 and 92 feet below land surface. Based on the heterogeneous quality of the subsurface described in other logs, it is highly unlikely that the shallow artesian zone is 53 feet thick throughout the entire site. In the North Marsh Area, many of the water table zone wells are screened below a depth 36 feet placing them, stratigraphically, in the shallow artesian zone with no intervening confining layer.

On August 2, 1982, in order to design a more adequate pumping program at the facility, RES ran a number of short term well tests in the water table zone. As described in Chapter III, an alternating sequence of pumping wells was used whereby each well would be pumped for 12 hours with 6 hours overlap between the time one well would be turned on and the previous one turned off. Distance-drawdown graphs were made for each pumping well after 12 hours of continuous pumping. Using these graphs, drawdowns at midpoints (between two pumping wells) were determined. For adjacent pumping wells the midpoint drawdown measurements were added and the resulting value represented the minimum drawdown between two pumping wells. If there was no drawdown at the midpoint, RES concluded that another abatement well would be needed. Field determinations were matched with formula calculations. Calculations based on Jacob's straight line method were used to determine transmissivity, storativity and hydraulic conductivity. A formula from a text book by Todd (1959), Ground Water Hydrology, was used to check the adequacy of the drawdown range between two wells:

$$Q = 0.5k[r(h_u + h_d)(i_u + i_d)] \text{ where:}$$

- Q= discharge rate of well in gallons per day
- k= horizontal permeability of aquifer in gpd/ft²
- = 3.14, constant
- r= half the distance between abatement wells
- h_u = upgradient saturated thickness of aquifer
- h_d = downgradient saturated thickness of aquifer
- i_u = upgradient hydraulic gradient
- i_d = downgradient hydraulic gradient

If the discharge rates determined from Todd's formula were greater than discharge rates in the field, abatement wells would have to be added to the system.

Both the field methods and formula calculations contain flaws. The superimposed "midpoint" drawdown between two pumping wells were obtained by assuming that the two wells were pumping for the same 12 hour time period. This, however, was not the case. In RES' sequential pumping scheme, two adjacent wells would pump simultaneously for only 6 hours. No steady state was reached since during that time period the midpoint observation well was affected by starting up one of the wells. The observation wells may have been influenced by the residual drawdown effects from other pumping wells and natural diurnal effects. The midpoint values, important field measurements that determine the pumping zone of influence, may, as a result of this test method, be higher than they should be.

The flaws in the formula calculations used to check the field results are serious because they are based on fallacious assumptions. RES used Jacob's straight line method (for a discussion of this method, see Kruseman and DeRidder, 1970) to determine values for transmissivity (T) and storativity (S). However, using this method in a unconfined aquifer usually requires that the aquifer be pumped for greater than 12 hours in order that $u < 0.01$ (u is a parameter within the Theis equation). Delayed yield affects of the water table aquifer, which are needed to calculate T and S, are not taken into consideration. However, even if delayed yield occurs during the 12 hours of pumping, it would be masked by the effects of turning off one of the pumping wells. Todd's formula is also based on strict assumptions. This formula which describes a minimum Q (flow rate) to produce drawdown between two pumping wells, assumes fully penetrating pumping wells and steady state conditions. Both of these conditions are not met in this study. Values used in the equation are suspect. After review of appropriate well logs, aquifer thickness calculations appear to be unsubstantiated. Because of continuous pumping at the facility, static water level measurements are difficult to obtain. The values that RES uses are estimates in many cases and are not based on field data. Because of a lack of sound geologic and hydrologic information at the site, the pumpage rates that RES had determined to be necessary to confine contaminated ground water to the site may be inadequate.

Another purpose of the above study was to establish a schedule for intermittent pumping once required pumping rates were determined. In comparing static water levels and induced water levels near abatement wells, RES computed how much time a well could be turned off and still contain "a drop of water" within its cone of drawdown. For example, if a pumping gradient is 12 times steeper than the natural gradient, by pumping a well for 1 day and leaving it off for 12 days, theoretically, contaminated ground water will not leave the capture zone. Once again, however, the values used in the calculations are suspect. Static water level gradients

are often estimates and induced drawdown gradients may be affected by other pumping wells. Also, the assumption that this scheme works is a theoretical one, not based on any field studies. RES concludes that the average total pumping rate in this alternating pumping scheme should be 97 gpm (140,000 gpd) to effectively maintain an adequate pumping barrier to confine ground water contamination to the site. However, upon review of the data used to make these calculations, this pumping scheme may need substantial revision. Moreover, the system has been developed to prohibit contamination from leaving the site; it is a passive system. It is not designed to actively remediate contamination.

Since 1972, when ground water contamination beneath the facility was first documented, RES has used total dissolved solids (TDS) as the parameter to define the limits of the contaminant plume. Substantial organic contamination was detected in 1981. RES contends that the extent of organic as well as arsenic and heavy metal contamination is also "confined to the RES site and that the 500 mg/l TDS line accurately describes the extent of . . . contamination." The facility concludes that, "based on indicator parameters (TDS, TOC, TOX, and phenols), the extent of contamination in the water table zone is virtually unchanged since [1983], indicating that continued pumping of the abatement well system is effectively confining contaminated ground water to the site."

For the most part, TDS levels have not changed substantially through time. There does, however, appear to be some migration of highly mineralized water toward the North Marsh Area. The highest levels are recorded adjacent to the unlined L-series lagoons. While the lagoons are known to be leaking, some of the very high readings may be a function of induced recharge of the nearby pumping wells. In its annual submittals, RES appears to interpret data with an obvious bias. If TDS levels are increasing at a certain well, RES contends that nearby abatement wells are responsible by drawing in and capturing contaminated ground water (thereby temporarily increasing contamination in the observed area). If TDS levels are decreasing at a well, RES contends that the abatement system has adequately reduced contamination in that area. Thus, by following RES' philosophy: if TDS levels are higher, the abatement system is working; if TDS levels are lower, the abatement system is also working.

As mentioned previously, detection limits for some parameters (lead, arsenic and TOX) have been higher than the respective drinking water standards. In the 1986 annual survey, lead and arsenic detection limits were lowered to appropriate levels; however, TOX detection limits of 1 ppm were still inadequate. 50 ppb total volatile organics is a standard operating base level signifying contamination. During 1986 and 1987 more rigorous evaluations were made of RES ground water quality problem. A Comprehensive Ground Water Monitoring Evaluation (CME) in 1986 as well as this Task Force have found significant organic contamination at the site.

Highly mineralized ground water (signified by high TDS) is most prevalent adjacent to the L-series lagoons. Ground Water contaminated with metals in the North Marsh Area near Well 4A. Organics are also found in the Main Plant Area. Very little monitoring has been done in the South Marsh Area. This area is of importance as it is downgradient from the leaking L-series lagoons and may act as a contaminant pathway to Raccoon Creek.

Sampling for volatile organic compounds by RES in 1986 resulted in the detection of several organic compounds in low concentrations at Well DP5 which is screened in the shallow artesian zone. DP1 has a relatively high phenolic concentrations (0.10 ppm) and all of the deep wells show elevated nitrate levels. The deep wells in the North Marsh Area, which may be directly connected or a part of the shallow artesian zone in that area, show contaminant concentrations similar to those of shallow wells in the same area. Because these wells are screened as deep as 70 feet below land surface, there are implications of significant pathways for the downward migration of contaminants in North Marsh Area. Even at a depth of 70 feet, sand is encountered.

While the 500 ppm TDS line may delineate the boundary of highly mineralized water, it cannot be used to define the extent of organic or heavy metal contamination - there is no causal relationship between high TDS and organics or metals. These "plumes" of contamination are centered in different areas and because the hydrogeologic regime is complex (and certainly not simplified by the alternating pumping sequence), direction of flow may be different as well. Wells MA10, MA11, E and AV2, which all lie outside the 500 ppm TDS contour line, show metal and/or organic contamination. It is uncertain whether there is organic or metal contamination within the South Marsh Area as this area has not been adequately monitored.

As RES' monitoring program becomes more complex, especially now that organic contamination must be assessed, the integrity of the existing well system becomes more important. Some of the wells on site, such as the W-series in the South Marsh Area, are well points and were not meant for rigorous ground water monitoring. During the inspection, caps were off wells (MW1a) and other were bent (Well 15). In the North Marsh Area, the inspection team members were able to lift some of the MA-series wells (MA10, MA11) out of the ground manually. Wells MA-5I through MA-11I and D were not constructed properly. The annular spacing was filled with drill cuttings. This may develop a vertical pathway whereby contamination in the shallow zone may enter deeper zones. In some of the deep MA-series wells, contamination is pronounced. Poor well construction may be a contributing factor to ground water degradation at depth in the North Marsh Area. Some of the wells which were installed at the facility during the early and mid 1970s are not supported by adequate well logs and construction details and, therefore, should not be used in a long-term sampling assessment or corrective action program.

6. Conclusions and Recommendations

The RES facility has been in operation for 18 years. In the early 1970s RES treated, stored, and/or disposed of hazardous waste in surface impoundments, basins, landfills, etc. throughout most of the 78 acre site. Many of these units were unlined and probably the source of organic and inorganic contamination to soils and the underlying water table aquifer. RES began to scale down their operations in the late 1970s by closing and backfilling many of the units in the Central Plant Area. In 1986, RES completed hazardous waste stabilization and final capping of the B-series basins (Basin Closure Area) in the northern portion of the facility. Currently, RES only incinerates hazardous waste. Residue from this process is manifested off-site as a hazardous waste. Pretreated scrubber effluent is sent to the RCRA regulated L-series lagoons. After cooling, the water is discharged to Raccoon Creek under the limitations imposed by a NJPDES permit. The only other regulated units at the site are basins B-206 and B-207, both part of a biological treatment system which only accepts on-site generated sanitary waste and ground water captured by the contamination abatement well system. This water is also discharged to Raccoon Creek via the L-series lagoons. Closure plans for B-206 and B-207 and the L-series lagoons have been submitted to NJDEP and EPA. RES intends to replace these units with above-ground tanks.

The unlined or clay-based L-series lagoons are known to be leaking highly mineralized water into the underlying water table zone. It is not certain if B206 and B207 are leaking as they accept the same contaminated ground water which underlies the units. Waste stabilization and capping of the Basin Closure Area was recently completed. These actions were designed to minimize ground water contamination in the future. Besides these specific areas, other sources of ground water contamination must be generalized to include much of the Central Plant Area where waste was stored and/or treated.

RES began to study ground water contamination in 1972; however a formal monitoring and plume assessment plan was not instituted until November, 1981, through a signed Consent Order with the State. Although the facility has installed close to 200 wells in and around the site (not all are currently in use or operable) and has a ground water abatement system in place, RES' current assessment program has not adequately defined site hydrogeology or the rate and extent of contamination beneath the site pursuant to 265.93(d). Two generalized cross-sections were developed in 1972 as part of their first report. The only other cross-sections were drawn in 1982 to show the existence of a vertical downward ground water flow gradient at the site. RES contends that there are two discrete aquifers beneath the facility: a water table zone and a shallow artesian zone. Review of well logs does not support this view. Site geology is very complex; RES must use available data to adequately characterize the subsurface. Additionally, more exploratory drilling should be done.

Down hole geophysics should be used at existing wells where possible and at all future wells for the same purpose.

Well tests of 1981 and 1982 were not adequate to characterize the hydrologic regime at the site. Longer term well tests, 48 to 72 hours, need to be performed in the water table aquifer so that hydraulic effects during and after delayed yield can be evaluated. Any well used for pumping or observation must be evaluated for construction integrity and must be supported by adequate well logs. Well tests in the shallow artesian zone is a more tenuous proposal because of the possible induced downward migration of contamination associated with the tests. Pumping the shallow aquifer as a means of stressing the shallow artesian zone should be considered. Transmissivity and storativity values of the shallow artesian zone north of the Basin Closure Area are reasonable; values for the water table zone are more suspect. Information from current geologic logs or new drilling projects must be integrated into the interpretation of well test results. Static water level gradients from the water table and shallow artesian zones, aquifer thickness, and the extent and thickness of clay lenses or layers, are all parameters which have not been adequately evaluated. RES should drill more deep wells on the site; the 5 existing ones are not enough to understand ground water flow and other hydrogeologic characteristics of the shallow artesian zone.

General parameters such as TDS, TOX, phenols, and metals have been used by RES to define the extent of ground water contamination since 1972. These parameters, by themselves, are not adequate as they do not consider the specific organic contaminants detected at the facility. Even the TOX parameter, which is a general parameter for organic contamination, has not been used properly, as the detection limit has been higher than the drinking water quality standard. RES did submit a new sampling program containing a more rigorous list of parameters to the State in 1986 but this was not agreed upon and was never implemented. RES must implement a program which tests for specific constituents detected in the Task Force sampling inspection and previous sampling efforts and must define the rate and extent of contamination based on this more comprehensive list of parameters. This will entail the installation of new monitoring wells.

Specifically, contaminant information is lacking in the South Marsh Area, the shallow artesian zone in the Central Plant Area, and the northern extent of the North Marsh Area where contamination had been found to a depth of 70 feet. RES contends that this is a deeper portion of the water table zone. RES must show that this is not actually an extension of the shallow artesian zone. RES must also define the vertical extent of contamination; 70 feet is only the depth of the deepest well in the area. Earth resistivity profiles suggest highly mineralized water may exist to depths of 100 feet. Values obtained using a 100 feet electrode

spacing are very low (40-100 Ohm-feet) around the L-series lagoons and the Central Plant Area. Resistivity information should be thoroughly integrated with geologic interpretations.

Capping and stabilization of waste in the Basin Closure Area was instituted to permanently reduce leachate seeping into the ground water. While an immediate amelioration of water quality is not expected, improvement in ground water quality over time should be observed. Specific well locations should be considered to monitor ground water flow beneath the Basin Closure Area. These locations would also be part of an overall sampling program. In order to adequately monitor the area, deeper wells must be installed and the integrity of existing ones must be checked. Neutron probes, already part of RES' original plan for Basin Closure, should be used to determine the moisture content below the cap. Care must be taken in the interpretation, however, as the variable chemistry of the waste constituents may affect the results. These are all tools to assess the effectiveness of Basin Closure. They should be incorporated in a plan which describes how RES will determine whether Basin Closure procedures are adequate to mitigate ground water contamination.

7. References

In addition to Quarterly and Annual Ground Water Reports, Aquifer and Contamination Evaluation Reports by RES' consultants, Geraghty & Miller, and State and Federal Inspection Reports, the following is a list of references used in this evaluation:

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- Widmer, K., 1964, The Geology and Geography of New Jersey: The New Jersey Historical Series Volume 19: New Jersey, D. Van Nostrand Company.
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E. Review of RES' Ground Water Sampling and Analysis Plan

The sampling and analysis plan titled "Groundwater Sampling Protocol," dated January 1987, was reviewed to determine compliance with 40 CFR § 265.92 and the Administrative Consent Order administered by NJDEP. The following inadequacies exist and should be corrected in a revised sampling and analysis plan:

Safety

The plan should provide a provision for air monitoring above the well heads in order to determine the potential for fire, explosion, and/or toxic effects on the workers. This segment should include the type of air monitoring device (i.e., OVA, HNU, detection tubes, explosimeter, etc.), a detailed description of the calibration procedures, and procedures for its use in the field.

Protective gloves should be worn when performing ground water monitoring and sampling activities (i.e., nitrile, viton, neoprene).

Field Measurements

The present Sampling and Analysis Plan uses a chart of total measurements taken at the time of well installation. The plan should contain a provision for measuring total depth of each well. This measurement can be used to check the structural integrity of the well (i.e., whether or not the well has silted in).

A permanent and easily identified reference mark from which water level and total depth measurements are taken should be installed on each well. The reference points should be established by a licensed surveyor.

Duplicate water level measurements on every fifth well should be taken to check accuracy of measurements.

The plan does not contain provisions for the detection and sampling of immiscible contaminants (floaters and sinkers) in the groundwater. The plan should specify in detail, the device as well as the construction material and procedures for detecting, measuring, and sampling both light and heavy phases.

The plan should provide identification by ID # of all field instruments in order to verify calibration procedures.

Backup equipment should be available if equipment malfunctions. All in-situ parameters should be measured immediately upon sampling. It is not acceptable to bring the sample back to an in-house laboratory in order to perform the analysis.

Calibration standards should be dated (i.e. pH buffers, specific conductivity standards). They all have specified shelf lives.

Purge Methods

In the decontamination procedure of the centrifugal pump, the plan should include a procedure for the cleaning of the outside of the intake line which comes in direct contact with the water being removed.

There are no provisions in the plan on the use and construction material of the hand pump used by RES. Details need to be provided.

During purging of the well, in-situ parameters of the purged water should be used to measure purging efficiency and to ensure that all stagnant water in the well has been replaced by fresh formation water.

Purged water from all the wells sampled must be collected for proper disposal. The disposal procedures should be specified in detail.

Recordkeeping

All field and laboratory measurements should be recorded in a numbered and bound notebook with non-soluble ink. This includes measurements recorded on 'Water Sampling Logs'.

The Water Sampling Logs should be expanded to include the following information: condition of the well (i.e., rust present, bent casing, label missing, etc.), air monitoring device readings, sample characteristics (i.e., odor, color, turbidity, presence of non-aqueous liquids, etc.) and sampling time (begin/end).

Sampling

In wells using dedicated submersibles, sufficient time must be allowed for ground water to stabilize prior to sampling. Pumps cause volatilization and produce pressure differentials which result in variability in the analysis of pH, specific conductivity, metals and volatile organics.

Sampling utilizing an in-line tap on the submersible should be eliminated and replaced with sampling by bottom loading stainless steel or teflon bailers.

Filtering for dissolved metals should be specified in the plan as being performed immediately after sampling.

Filtering procedures for dissolved metals should be expanded to include cleaning apparatus with 10% HNO₃ solution and D.I. water prior to sample filtration.

Sample containers should be labeled to identify if preservations have been added to avoid overfilling. Preservation of the sample should be verified with pH paper to see if the required amount of preservative has been added.

The plan lists the order of preferred sample collection for various parameters. TOX and TOC should be moved up to numbers four and five, respectively, since they typically contain volatile components.

The plan describes what EPA considers to be an inadequate cleaning procedure for sampling equipment. The following should be done in the order detailed below:

Wash and brush with hot tap water and nonphosphate detergent; rinse with tap water, 10% nitric acid, tap water, methanol, hexane, deionized water (demonstrated analyte free); air dry; wrap in aluminum foil, shiny side out. All solvents, including acids, must be reagent grade.

For those sampling events where only organic parameters are being analyzed, the nitric acid rinse can be skipped. If only metals are being analyzed the methanol and hexane rinses can be skipped.

The plan needs to describe cleaning procedures for sample containers as well as laboratory glassware. For samples analyzed for metals, the following should be done, in the order detailed below, for containers and glassware:

Wash with hot tap water and nonphosphate detergent; rinse with 1:1 nitric acid, tap water, 1:1 hydrochloric acid, tap water, deionized water (demonstrated analyte free). All acids must be reagent grade.

For samples analyzed for organics the following should be done, in the order detailed below, for sample containers as well as laboratory glassware:

Wash with hot tap water and nonphosphate detergent; rinse with tap water, methanol, hexane, deionized water (demonstrated analyte free). All solvents must be reagent grade. All glassware (sample or laboratory) for volatiles must be muffled at 105°C for a minimum of one hour.

All sample containers and laboratory glassware must be sealed and stored in a clean environment. The cleanliness of each batch of precleaned items must be verified by laboratory analysis. The procedures should be detailed in the plan.

Any specialized cleaning, eg., TOX containers muffled at 400°C, should be detailed.

The use of trip blanks needs to be detailed. One trip blank per day of sampling, or every twenty samples, whichever is more frequent, should be used. A trip blank only needs to be used if samples are being taken and analyzed for volatiles, including TOX and TOC. A trip blank only needs to be analyzed for those volatiles being sampled for at a site.

A trip blank is defined as a sample container that is filled with demonstrated analyte free water; transported to the site and handled like a sample without opening the container; and returned to the laboratory for analysis.

Chain of Custody Procedures/ Packaging and Shipping

The plan describes chain of custody procedures for analysis of samples by the on-site RES laboratory. However, it does not provide any information about procedures for samples shipped to off-site contractor laboratories. Such information such as use of sample seals and chain of custody forms should be addressed in detail in the plan.

Include a copy of the chain of custody seal and form as an attachment to the plan.

A section on sample packaging and shipment (as per DOT regulations) to an outside laboratory should be incorporated.

Well Construction

On a number of wells (PVC material construction) the well caps could only be removed with considerable effort, or not at all, preventing the taking of water level measurements and/or sampling. It is recommended that holes be punched in the caps or gas vents be installed to release air pressure from built up gas which may become trapped, providing easy removal of the cap.

On a number of wells (most notably the MA-11 series) no concrete collars were seen and water was visibly present between the well casing and outer protective casing. In some cases, due to the difficulty in removing the well cap, it was possible to physically move the well by lifting it. These observations lead us to question the structural integrity of the well construction, in particular, the annular seal which prevents the migration of contaminants to the sampling zone from the surface or intermediate zones. These problems question the monitoring well program's ability to detect contamination from discrete zones (shallow, intermediate, and deep).

Protective bumpers should be installed on all on-site wells where daily activity could damage the well (i.e., Well 13 - bent casing).

Permanent labels, protective casings, and locks should be installed on all monitoring wells.

RES should implement a monitoring well inspection program. This program should incorporate a log of information such as: casing condition, labels installed, locks installed, etc.

Analytical Methods and Associated Quality Control

As a general comment, the plan, including the document titled "Quality Assurance Program" dated March 10, 1986, fails to provide adequate details of the quality control that is specific to ground water monitoring analyses. Additionally, important details of certain analytical methodology are missing. Most of the comments below focus on the inadequacies of actual practice observed by us or explained to us. Most of the problems could not be identified by reviewing the plan. All problems regarding actual practice and lack of detail need to be corrected.

Both the analytical methodology and associated quality control used for total organic hydrocarbon (TOX) analysis are inadequate. Additionally, the details of actual quality control practice are lacking and the analytical methodology described for TOX analysis does not reflect actual practice.

The methodology being used can miss entire groups of halogenated compounds and result in significantly lower values and higher detection limits than the method EPA considers as appropriate for TOX determination, Method 9020 of EPA's SW-846. Also, the level of quality control being practiced does not provide adequate confidence in the reliability of the data for the compounds that are determined by the methodology being used. (See the Laboratory Audit Section of the report for further details on this matter.)

For all ground water monitoring parameters, the plan needs to provide detection limits and their method of determination. Simply referencing EPA analytical methods is not sufficient.

F. Audit of Currently Used Laboratories

As part of the HWGWTF's investigation of RES, an audit was performed by EPA Region II on April 15, 1987, of the RES Laboratory located in Bridgeport, New Jersey. Part of this audit focused on those problems identified in an NJDEP audit, pursuant to the Regulations Governing Laboratory Certification and Standards of Performance, N.J.A.C. (7:18), performed on January 13, 1987. These regulations currently do not directly govern analytical work performed under RCRA. However, that audit did cover RCRA parameters in the matrix of interest that are analyzed under other programs. This audit focused on the RCRA analytical work not covered in the NJDEP audit.

Environmental Testing and Certification Corporation (ETC), located in Edison, New Jersey has been contracted by RES to perform analyses of well samples for RCRA's "Appendix IX" parameters. ETC was audited in July, 1985, by the National Enforcement Investigation Center (NEIC) and in April, 1986, by the Quality Assurance Office of EPA, Region V. The findings as they pertain to this investigation are presented below.

It should be noted that the selection of ground water monitoring parameters being sampled for and analyzed by RES is based on an NJDEP Administrative Consent Order. The RES parameters are: pH, total dissolved solids total organic carbon, nitrate, phenol, arsenic, cadmium, chromium, copper, zinc, lead, polychlorinated biphenyls and total halogenated hydrocarbons (TOX).

1. RES Laboratory

Several inadequacies were found involving the use of inappropriate analytical methodology for analyses of TOX and the failure to follow the quality control procedures contained in the subject analytical methodology referenced for TOX analysis in RES' Ground Water Sampling Protocol. Additionally, the analytical methodology itself that is used by RES differs from that which is referenced in RES' protocol. The details regarding these matters are highlighted below.

RES' Ground Water Sampling Protocol references EPA Methods 601 and 608, 40 CFR 136, for TOX analysis. The appropriate method for TOX analysis is Method 9020 from EPA's Test Methods for Evaluating Solid Waste (SW-846).

Method 9020 is a method involving carbon adsorption with a microcoulometric titration detector. This method determines all organic halides containing chlorine, bromine, and iodine that are adsorbed by granular activated carbon under the conditions of the method.

Method 601, as prescribed in 40 CFR 136, involves purge and trap gas chromatography with a halide-specific detector. It determines 29 purgeable aliphatic halocarbons. The RES laboratory uses a flame ionization detector. The flame detector can determine a wider range of compounds, but is less sensitive than a halide specific detector. Consequently, low levels (ug/l range) of individual halocarbons can be missed with the flame detector.

Method 608, as prescribed in 40 CFR 136, involves methylene chloride extraction, gas chromatography, and an electron capture detector. It determines certain organochlorine pesticides and PCBs. The RES laboratory

uses methylene chloride extraction, gas chromatography, and a Hall detector. The use of a Hall rather than electron capture detector can determine a wider range of non-purgeable halocarbons. However, the Hall is less sensitive than an electron capture detector. Additionally, certain groups of compounds, such as the chlorophenols, are missed using the 608 extraction procedure.

RES quantitates TOX using total peak areas. Detection limits for individual compounds are based solely on the linear regression intercept of the halocarbon standards. For purgeables the lowest standard used is 270 ug/l and for nonpurgeables it is 50 ug/l. Additionally, a 1 mg/l detection limit is used when reporting actual TOX, which is based solely on the limit reported by the laboratory originally doing TOX for RES. Concentrations determined that are less than 1 mg/l are reported as "less than 1 mg/l".

It should be noted that until 1984, SR Analytical in Cherry Hill, New Jersey, was contracted by RES for TOX analyses and apparently used the analytical methodology currently being used by RES.

Regarding quality control procedures, many of those prescribed in EPA Methods 601 and 608 are not being used by RES. Regarding both Methods 601 and 608, the following inadequacies exist:

- a. External QC check samples are not being used.
- b. Calibration check standards are allowed to be out by as much as 20% without action being taken. The action limit prescribed in Methods 601 and 608 is 10%. For Method 601, RES has been out by as much as 20%; for Method 608 RES has been out by more than 10%.
- c. No checks are made on the validity of standards being used.
- d. Laboratory duplicates are not used; a form of field duplicates are used.
- e. Surrogates are not used.
- f. Control charts for precision and accuracy are formulated based on TOX rather than on individual methods and parameters.

- g. Data validation procedures are not well established in terms of the appropriate control charts and other quality control measures for determining the validity of data based on specific criteria.

Regarding Method 608, the following additional inadequacies exist:

- a. An initial demonstration of capability to perform the method was not performed.
- b. A holding time of 14 days for sample extraction is typically being used rather than the 7 days required by 40 CFR 136.

Regarding good laboratory practices in general, written standard operating procedures do not exist for any analysis performed as part of RES' ground water monitoring program.

Additionally, systems audits are not performed by RES on any of the TOX or PCB analytical work performed as part of the RES ground water monitoring program.

Regarding problems identified by NJDEP during their January 1987 audit, all have been corrected with the following exceptions:

- a. A log book for documenting sample digestions has been established, but does not yet include information on pH checks.
- b. ICAP interference check samples have been ordered, but have not yet been received.

2. Environmental Testing and Certification Corporation (ETC) Laboratory

The audit by NEIC in July, 1985, and again by the Quality Assurance Office of EPA, Region V in April, 1986, revealed several inadequacies. Most of the inadequacies do not apply to the parameters of interest in this RES investigation. However, those few deficiencies pertinent to this investigation were corrected prior to the Task Force study.

G. Ground Water Sampling Activities at RES

On February 9-19, 1987, the Ground Water Task Force sampled for Appendix IX constituents at Rollins Environmental Services (RES), Bridgeport, New Jersey, in order to determine if the hazardous waste disposal, storage, and treatment activities conducted at this site and regulated by the Resource Conservation and Recovery Act (RCRA) have impacted the quality of ground water underlying this facility. The field sampling participants were as follows:

EPA Region II- ESD

Louis DiGuardia, Geologist
Joseph Cosentino, Environmental Scientist

EPA Sampling Contractor - Alliance, Inc.

Richard DeLuca
David Billo
Mark Lewis
William Naughton

Rollins Environmental Services (RES)

Mark Owens
Thomas Smith

The following EPA contractor laboratories were utilized by the Task Force:

Centec Analytical
2160 Industrial Drive
Salem, Virginia 24153

for total metals, dissolved metals, cyanide, POC, POX, TOC, TOX, phenols, anions, sulfides, carbonates and bicarbonates.

EMSI
4765 Calle Quetzal
Camavilla, CA 93010

for VOA, BNA, Pesticide/PCB, and Herbicides.

Compu Chem Laboratories
3308 Chapel Hill/Nelson Highway
Research Triangle Park, NC 27709

for Dioxins.

The sampling procedures followed during the inspection were those described in the Work/QA Sampling Plan for the Ground Water Task Force Inspection Plan at RES. Safety equipment, utilized by all members of the Task Force, consisted of surgical gloves, neoprene gloves, saranac tyvek, safety boots/ shoes, disposable booties, protective coveralls, cartridge respirators and SCBAs. All Task Force activities at RES were conducted by the Task Force contractor, Alliance, Inc. RES elected to receive splits of all samples collected by the Task Force. The order of sample collection and the preservation methods and parameters for which the samples were analyzed are summarized in Tables A-1 and A-2.

During the inspection, samples were collected from 21 ground water monitoring and abatement wells. Of these wells, 18 were screened in the water table zone and 3 were screened in the shallow artesian zone. Table A-3 is a list of well specifications for RES' ground water monitoring wells supplied by their consultant, Geraghty & Miller.

Before and after sampling activities, full rounds of water level measurements were taken (from wells which were sampled as well as other wells at the site) with a water level indicator/sounder to the top of the PVC casing, using the measuring point from which RES makes its routine ground water measurements (Table A-4). The water level indicator was decontaminated between wells with isopropanol and deionized water and air dried. Duplicate water level measurements were taken at a representative number of wells to check measurement procedures. Differences between measurements ranged from 0.0 to 0.11 ft. and were considered to be within an acceptable range (Table A-5).

After the initial round of water level measurements was taken, a water level measurement was taken at each well that was sampled (Table A-6). Prior to and throughout sampling activities, the air space above and around the well head was measured with air monitoring equipment in order to determine the need for respiratory protection. These instruments included an organic vapor analyzer (OVA), a photoionization detector (HNU), and a geiger counter. Table A-7 presents the results of air monitoring obtained at each well. An interface probe was used to determine the presence of immiscible layers.

Purging and sampling of Wells AV-2, S, MA-3S, 17, MW-4A, W27, W24, W29, MA-1S, and L-2 was performed using dedicated bottom loading teflon bailers. For Wells 29, 25 and 21A, purging was performed using the facility's dedicated submersible pumps with sampling performed using bottom loading teflon bailers. Wells MA-9S, MW-4A, MA-8D, and MA-11D were purged and sampled using dedicated one-inch bottom loading stainless steel bailers. For wells screened in the shallow artesian zone (DP-1, DP-2 and DP-5), a portable stainless steel submersible pump (Label SP-2) supplied by Alliance was utilized. Sampling was performed using a bottom loading teflon bailer.

The portable submersible pump (SP-2) utilized by the Task Force was constructed of stainless steel with a PVC coated electrical cable and discharge line.

Decontamination between wells consisted of a tap water non-phosphate detergent wash and triple deionized water rinse of the internal system, with a similar cleaning followed by an acetone and hexane rinse and air drying for the outside pump, discharge line, and electrical cable. All decontamination and purge water was collected by RES in 55-gallon drums for treatment in their unit treatment facility. The bottom loading teflon and stainless steel bailers were cleaned and rinsed prior to entering the field. This procedure consisted of a thorough hot water and non-phosphate detergent wash followed by successive rinses with deionized water, acetone and hexane. After being air dried, the bailers were wrapped in aluminum foil (treated side out). Cleaning procedures were verified by taking equipment blanks for each batch cleaning of bailers and the SP-2 submersible pump.

In-situ measurements were taken for pH, specific conductivity, and temperature and are summarized in Table A-8. Instrument calibration was performed before the start of field activities and prior to the taking of field measurements. Samples were preserved upon completion of sampling at each location. The samples for dissolved metals were returned to a RES in-house laboratory for filtering by EPA personnel. The following procedure was employed: the sample was pre-filtered with a 5.0 um glass fiber filter followed by filtering with a .45 um filter and then preserved with HNO_3 . Cleaning of the apparatus consisted of a deionized water rinse followed by nitric acid rinse and final deionized water rinse.

Upon completion of daily sampling activities, the samples were packaged in accordance with applicable Department of Transportation (DOT) regulations for shipment to the appropriate EPA contractor laboratories. RES was issued a receipt for all samples collected by the Task Force and returned it with a signature from an authorized representative.

H. Task Force Sampling Data Analysis

The data for ground water samples taken at RES Ground Water Task Force between the period February 9-19, 1987, are presented in Appendix A, Table A-9 through A-14. Twenty-one field samples plus nine volatile sample blanks (001, and 100 through 107) were collected at the facility. The samples included seven field blanks (101, 100, 102, 103, 105, 106, and 107), three equipment blanks (104, MQA-738, and MQB-001), a trip blank (MQB-002), two pairs of duplicate samples (Well MW-4A, samples MQA-736/MQB-736 and MQA-743/MQB-743 and Well 29, samples MQA-739 and MQB-011), and twenty-one other field samples. Field measurements for pH, specific conductivity, temperature and turbidity are presented in Table A-8.

All data for inorganic and indicator parameters as well as metals (total and dissolved) are tabulated in Tables A-9, A-10 and A-11, respectively. For organics, only those compounds which were detected in at least one of the wells are listed. Data for organic analyses are presented in Table A-12 for volatiles and Table A-13 for semi-volatiles. The results of field and equipment blanks can be found in the raw data packages from the respective laboratories. Data qualifiers for Tables A-9 through A-14 are presented in a key in front of Table A-9. An evaluation of data quality control is attached in Appendix B.

1. Inorganic and Indicator Parameters

All carbonate, bicarbonate, nitrate, and nitrite sample results were rejected since the laboratory exceeded sample holding times. Because of total organic halogen (TOX) contamination found in an equipment and field blank, only TOX results ten times the level of contamination or greater were considered acceptable for data presentation. Sulfide values were rejected due to blank contamination.

In general, the highest levels of indicator parameters were found in samples from Wells MA-1S, 29, MA-2D, W-24, and 17. The highest concentration of TOX were found in MA-1S (21,300 ug/l), 29 (5,380 ug/l), MA-2D (4,100 ug/l) and 17 (574 ug/l). Purgeable organic halogens (POX) concentrations generally correlated with TOX values with the exception of MA-2D, where POX was found to be 11,000 ug/l and TOX to be 4,100 ug/l. Purgeable organic carbon (POC) and total organic carbon (TOC) values ranged from 42 ug/l to 28,000 ug/l, and 1,700 ug/l to 267,000 ug/l respectively. Total phenol concentrations were present in the highest concentrations in Wells MA-1S (5,000 ug/l), 29 (888 ug/l), and MA-2D (888 ug/l).

Among the inorganic constituents analyzed, bromide was found to be present in the highest concentration in 21A (30 mg/l). Chloride and sulfate were present at the highest concentrations in Well 25 with values of 2,250 mg/l and 2,700 mg/l, respectively. Fluoride was found

in the highest concentration in Well MA-1S at a value of 16 mg/l. Table 3 summarizes the range of concentrations of inorganic and indicator parameters which were found in ground water samples collected by the Task Force at RES. Result of inorganic and indicator parameter analyses from samples obtained from individual wells are presented in Appendix A, Table A-9.

Table 3 - Inorganic and Indicator Parameter Analyses

Parameter	Number of Wells Constituent Present	Range of Concentrations Present (mg/l)
Bromide	6	2.3 - 30
Chloride	23	21 - 2250
Fluoride	10	1 - 16
Sulfate	22	12 - 2700

Parameter	Number of Wells Constituent Present	Range of Concentrations Present (ug/l)
POC	23	42 - 28000
TOC	21	1700 - 267000
Phenols, totals	3	888 - 5000
POX	12	6 - 11000
TOX	4	574 - 21300

2. Metals Analyses Results

Reported detection limits are contract required detection limits (CRDL) or lower for all metals. Dissolved arsenic data for samples MQA-739 and MQA-741, total cadmium samples for MQB-008, MQB-010, MQB-025, and total antimony for MQA-774 were rejected due to correlation coefficients for the method of standard addition (MSA) being below data quality objectives. Dissolved and total mercury data for samples MQB-012, MQB-013, MQB-014 and MQB-015 were rejected due to failure in obtaining matrix spike recoveries because of unknown salt interferences. Dissolved selenium data for samples MQB-006 and MQB012 were rejected due to duplicate injection precision being above DQO. Total cyanide data for samples MQB-001 and MQB-010 were rejected due to high sulfide interference in the matrix spike recovery. Table 4 summarizes the range of concentrations of Appendix IX metals (total and dissolved) which were found in the ground water samples collected by the Task Force at RES. The results of metal analyses from samples obtained from individual wells are presented in Appendix A, Tables A-10 and A-11.

Table 4 - Appendix IX Metals (Total and Dissolved)

Metal Constituent	TOTAL		DISSOLVED	
	Number of Wells Constituent Present	Range of Concentrations (ug/l)	Number of Wells Constituent Present	Range of Concentrations (ug/l)
Aluminum	22	190 - 360000	16	44 - 820
Arsenic	13	7.8 - 472	5	7.5 - 264
Barium	23	32 - 1040	23	31 - 121
Beryllium	8	2 - 25	1	3
Cadmium	6	.6 - 7.5	4	1.0 - 6.9
Calcium	23	6390 - 451000	23	7600 - 515000
Chromium	15	18 - 7880	ND	ND
Cobalt	10	20 - 122	3	21 - 35
Copper	20	12 - 4890	6	8 - 74
Iron	23	386 - 438000	21	27 - 151000
Lead	22	4.1 - 192	6	2.4 - 40
Magnesium	23	2100 - 256000	23	2380 - 299000
Manganese	23	69 - 2140	23	35 - 2440
Mercury	7	.3 - 3.7	ND	ND
Nickel	10	26 - 184	1	150
Potassium	23	2320 - 48300	23	2600 - 54400
Sodium	23	3070 - 1710000	23	3020 - 1570000
Vanadium	15	17 - 1100	4	14 - 311
Zinc	23	19 - 1350	21	16 - 162
Cyanide	3	40 - 80	NA	NA

ND - Not Detected

NA - Not Analyzed

- a. The following metals results were noted in the water table zone:

Total Metals

The highest concentrations for aluminum, barium, beryllium, cadmium, chromium, cobalt, copper, iron, lead, manganese, nickel, potassium, sodium, vanadium and zinc were found in Wells MW-4A and 17.

Arsenic, calcium and magnesium were present in the highest concentrations in Well 25.

Cyanide was present in the highest concentrations in Wells MW-4A and 25.

Dissolved Metals

Arsenic, calcium, magnesium, nickel, potassium and vanadium were present in the highest concentrations in MA-2D and 25.

Barium, iron, and manganese were present in the highest concentrations in MA-1S.

Beryllium was present in the highest concentration in MA-11D.

Cadmium was present in the highest concentration in W-29.

Cobalt and zinc were present in the highest concentrations in MA-8D.

Lead was present in the highest concentration in MA-2S.

- b. The following metals were noted in the shallow artesian zone:

Total Metals

Aluminum, calcium, cobalt, copper, magnesium, potassium, and zinc were present in the highest concentrations in DP-5.

Iron, lead, manganese, and sodium were present in the highest concentrations in DP-1.

Barium and cadmium were present in the highest concentrations in DP-2.

Dissolved Metals

Aluminum, calcium, cobalt, copper, lead, magnesium, potassium, and zinc were present in the highest concentrations in DP-5.

Iron, manganese, and sodium were present in the highest concentrations in DP-1.

Barium and cadmium were present in the highest concentrations in DP-2.

3. Organic Analyses Results

All pesticide and herbicide analyses did not pass QA/QC review and were rejected. The analytical laboratories exceeded the volatile holding times of seven days for all volatile samples; therefore, all results from volatile samples will be considered qualitative. Acetone contamination was found in sampling blanks 001, 100, 101, 102, 103, 104, 105, 106, 107, MQA-738, MQB-001 and 002. All acetone results were rejected. Methylene chloride contamination was found in sampling blanks 103, 104, MQA-738, MQB-001 and 002. All methylene chloride results were rejected. Laboratory method blanks MB-2 and MB-4 contained bis(2-ethylhexyl) phthalate contamination at concentrations of 3 and 4 ug/l. All positive bis(2-ethylhexyl) phthalate data were rejected. Table 5 summarizes the occurrence and range of Appendix IX organic constituents found in the ground water samples collected by the Task Force at RES. Results of organic analyses from samples obtained individual wells are presented in Appendix A, Tables A-12 and A-13.

Table 5 - Volatile Constituents

Parameter (ug/l)	Number of Wells Constituent Present	Range of Concentrations Present
Benzene	8	7 - 3100
2-Butanone	2	41 - 1300
Carbon DiSulfide	1	990
Carbon Tetrachloride	1	7
Chlorobenzene	6	7 - 360
Chloroform	6	2 - 700
1,1 - Dichloroethane	7	2 - 510
1,2 - Dichloroethane	6	20 - 300
1,2 - Dichloropropane	1	6
Ethylbenzene	6	1 - 720
2- Hexanone	1	1100
Tetrachloroethene	5	2 - 41
Trichloroethene	5	94 - 230
1,1,1 - Trichloroethane	5	1 - 860
Trans - 1,2 - Dichloroethene	7	3 - 1600
Toluene	8	2 - 10000
Total Xylene	4	9 - 2800
Vinyl Chloride	7	1 - 1000
1,2 Dibromoethane	1	11

Table 5 (cont.) - Semi-volatile Constituents

Parameter ug/l	Number of Wells Constituent Present	Range of Concentrations Present
Acenaphthene	1	1
Benzoic Acid	1	340
Bis(2-chloroethyl) Ether	5	1 - 200
2 - Chlorophenol	1	10
4 - Chloroaniline	3	2000 - 27000
1,2 - Dichlorobenzene	4	2 - 93
1,3 - Dichlorobenzene	3	4 - 5
1,4 - Dichlorobenzene	3	8 - 31
2,4 - Dichlorophenol	3	47 - 170
2,4 - Dimethylphenol	2	180 - 970
2 - Methylphenol	1	11
4 - Methylphenol	3	34 - 2100
2 - Methylnaphthalene	2	47 - 100
Naphthalene	3	110 - 1000
Phenol	3	1 - 380
Phosphorictriamide, Hexamethyl	1	13
1,2,4 - Trichlorobenzene	1	6
Acetophenone	1	410
Aniline	2	150 - 1700
2 - Hexanone	1	77
4 - Methyl - 2 - Pentanone	1	330
Pyridine	1	200
0 - Toluidine	2	960 - 2700

a. The following organic results are noted in the water table zone:

In general, the highest concentrations of hazardous organic constituents were found in the samples from monitoring wells MA-1S, 29, MA-2D, 17 and 24. Well MA-1S contained the highest levels of the following compounds:

° benzene	3100 ug/l	° vinyl chloride	1000 ug/l
° 2-butanone	1300 ug/g	° 4-chloroaniline	27000 ug/l
° chlorobenzene	360 ug/l	° 1,2 dichlorobenzene	93 ug/l
° chloroform	700 ug/l	° 1,4 dichlorobenzene	31 ug/l
° 1,1 - dichloroethane	512 ug/l	° 2,4 dimethylphenol	970 ug/l
° 1,2 - dichloroethane	300 ug/l	° 4-methylphenol	2100 ug/l
° ethylbenzene	720 ug/l	° 2-methylnaphthalene	100 ug/l
° 2- hexanane	1100 ug/l	° naphthalene	1000 ug/l
° 1,1,1 - trichloroethane	860 ug/l	° aniline	1700 ug/l
° trans - 1,2 Dichloroethene	1600 ug/l	° 4 methyl-2-pentanone	330 ug/l
° toluene	1000 ug/l	° pyridine	200 ug/l
° total xylene	2800 ug/l	° 0-toluidine	2700 ug/l

Well 29 contained the highest levels of:

- ° trichloroethene (230 ug/l),
- ° benzoic acid (340 ug/l),
- ° bis (2-chloroethyl) ether (200 ug/l),
- ° 2 chlorophenol (10 ug/l),
- ° 2,4 dichlorophenol (170 ug/l),
- ° phosphorictriamide, hexamethyl (13 ug/l), and the second highest concentrations of:

° chlorobenzene	69 ug/l	° 4-chloroaniline	2000 ug/l
° chloroform	440 ug/l	° 1,2 dichlorobenzene	38 ug/l
° 1,1 - dichloroethane	45 ug/l	° 1,3 dichlorobenzene	4 ug/l
° 1,2 dichloroethane	120 ug/l	° 2,4 dimethylphenol	180 ug/l
° tetrachloroethane	27 ug/l	° 4-methylphenol	160 ug/l
° 1,1,1 - trichloroethane	330 ug/l	° 2-methylnaphthalene	47 ug/l
° trans - 1,2 dichloroethen	51 ug/l	° naphthalene	140 ug/l
° toluene	570 ug/l	° phenol	370 ug/l
° total xylene	190 ug/l	° aniline	150 ug/l
° vinyl chloride	35 ug/l	° 0-toluidine	960 ug/l

Well MA-2D contained the highest levels of:

- ° carbon disulfide 990 ug/l
- ° 2- methylphenol 11 ug/l
- ° phenol 380 ug/l

Well 24 presented the highest level of carbon tetrachloride (7 ug/l).

Well 17 contained the highest concentration of:

- ° tetrachloroethene 41 ug/l and
- ° 1,2,4 - trichlorobenzene 6 ug/l

1,2 Dibromoethane was present in the highest concentration in well MA-8D, 2-hexanone in MW-4A (77 ug/l) and 1,3 dichlorobenzene in MW-27 (5 ug/l).

b. The following organic results are noted in the shallow artesian zone:

Hazardous organic constituents were detected only in samples from Well DP-5, located at the southeastern corner of RES. The sample from DP-5 indicated concentrations of:

- ° benzene 7 ug/l
- ° carbon tetrachloride 1 ug/l
- ° chloroform 5 ug/l
- ° 1,1 - dichloroethane 10 ug/l
- ° 1,2-dichloroethane 180 ug/l
- ° tetrachloroethene 2 ug/l
- ° trichloroethene 20 ug/l
- ° trans-1,2-dichloroethene 4 ug/l
- ° vinyl chloride 8 ug/l
- ° bis(2-chloroethyl)ether 1 ug/l

4. Dioxin/Furans Analyses Results

Table 6 summarizes the results of the dioxin/furans analyses on ground water samples obtained by the Task Force at RES. The only detected concentrations were found in the water table zone from Well MW-4A (sample # MQA-736). Duplicate analysis MW-4A DUP (sample # MQA-743), showed similar concentrations.

Table 6 - Dioxin/Furan Results

Parameter (parts per trillion)	MW-4A MQA-736	MW-4A(DUP) MQA-743
TCDD	U	U
PeCDD	U	U
HxCDD	U	U
HpCDD	U	U
OCDD	U	6.26
TCDF	1.54	1.87
PeCDF	U	3.34
HxCDF	3.86	11.9
HpCDF	20.1	26.5
OCDF	17.3	19.5

I. Compliance Evaluation Inspection

1. Facility Description and Operations

RES is a commercial treatment storage and disposal facility situated on a 78 acre tract in Bridgeport, Logan Township, N.J.. This facility accepts a wide range of hazardous waste for treatment: pesticides, halogenated aliphatic hydrocarbons, monocyclic aromatics, phthalate esters, polycyclic aromatics, ketones, alcohols and miscellaneous volatiles. Explosive wastes (DOT Classes A, B, and C), radioactive wastes, and PCB wastes are not accepted at the facility. Incineration is the only commercial operation at RES.

Currently, RES operates the incinerator under interim status regulations. Wastes are incinerated in gaseous, liquid and solid form. Incinerator ash, formerly landfilled on-site is now transported to secure landfills elsewhere. Scrubber water, from the venturi scrubber system is pre-treated in an on-site treatment system. This system consists of Neutralization Tanks, clarifier and centrifuge. The solids generated are transported to a secure landfill off-site. The resulting supernatant is discharged to a series of unlined surface impoundments. These eight L-series surface impoundments serve as a cooling system before discharge to the Raccoon Creek. Two lined biological treatment surface impoundments (B-206 and B-207) receive contaminated ground water from eighteen pumping wells on-site. Basin B-206 is used for equalization and preaeration while B-207 is used for activated sludge treatment. The treated water effluent is pumped to the L-series surface impoundment for ultimate discharge to Raccoon Creek. All ten surface impoundments are RCRA regulated units. From these impoundments, water is discharged to Raccoon Creek under the terms of RES' NJPDES Permit.

2. Hazardous Waste Storage

Drum Pad #1: This pad is located approximately fifty feet north of tank farm #1. The pad consists of a roof-covered concrete surface surrounded by a concrete containment sump. Steel drums as well as fiber drums, both stacked two high, are stored in this area. The maximum allowable quantity to be stored is 450, 55-gallon drums. This pad area is approximately 4200 square feet. The physical inspection revealed a small number of drums inadequately marked. In the center rear portion of this drum pad were located several drums between which was inadequate aisle space. Drum Pad # 2: This pad is located

Drum Pad # 2: This pad is located adjacent to the guard shack near the main gate entrance. This pad consists of a concrete slab with concrete curbing as containment. Only steel drums are stored in this uncovered area. Drums are stored on pallets, stacked one high. This pad area measures approximately 7200 square feet. The physical inspection revealed a small number of drums inadequately marked. The concrete slab had numerous small cracks throughout.

The drum pad inventory for both Pad # 1 and Pad # 2 can be found in Appendix C.

Phase # 1 Tank Farm: This consists of four steel storage tanks. This phase was constructed in 1978, following the destruction of the former tank area by fire and explosion in 1977. Tank descriptions are as follows:

Tank # T-301 - 7,000 gal. capacity - receiving
Tank # T-302 - 7,000 gal. capacity - receiving
Tank # T-303 - 20,000 gal. capacity - blend
Tank # T-304 - 20,000 gal. capacity - blend

All four tanks are equipped with mechanical agitators and pressure relief rupture disks. Containment provided for each tank consists of a cement pad and cement dike approximately four feet in height.

Phase # 2 Tank Farm: This consists of three steel storage tanks and is located south of Phase # 1 tank farm. Tank descriptions are as follows:

Tank # T-308 - 30,000 gallon capacity - storage
Tank # T-310 - 20,000 gallon capacity - thermalox storage
Tank # T-311 - 30,000 gallon capacity - storage

Tank # T-310 contains RES designated "Thermalox" aqueous waste containing approximately 90% water. Phase # 2 tanks are also equipped with mechanical agitators and pressure relief rupture disks. Containment provided for these tanks consists of a cement pad and cement diking. At this time a VC.0 exists in Phase # 2 tank farm where former Tank # T-312 was located. This tank was removed from site in 1986.

3. Other Storage Tanks

Tank # T-103: This provides 20,000 gallon capacity for the storage of RES designated "Thermalox" material. This tank is located outside of the two tank farm areas. There is no pipe connecting this tank and the tank farm areas. Containment for this tank consists of a cement pad with a cement curbing.

Tank # T-323: This is a large, 150,000 gallon capacity steel storage tank for bulk storage of hazardous waste. It is located on the Eastern part of the site away from the main facility. There is no piping connecting this tank to either tank farm or the incinerator. Containment consists of a pad and a berm constructed of clay like material.

All hazardous waste tanks are blanketed with nitrogen in order to reduce fire hazard.

4. Incinerator

The incinerator in use at RES consists of a rotary kiln and operates under negative pressure in order to reduce fugitive emissions. Incinerator controls incorporate a series of automatic fuel cut-off systems which shut down operations if any of the following conditions occur:

- Hot duct temperature falls below 2,000° F
- Loss of flame as measured by fire eye flame sensors
- Induction draft fans Axial vibration above 7 mils
- afterburner draft below 6 inches of water
- quenched gas temperature above 15 inches of water
- water flow to the saturator spray nozzels below 400 g.p.m.
- water flow to the saturator shelf below 100 g.p.m.
- water flow to the absorber below 2000 g.p.m.
- power failure
- CO concentration in the stack above 80 ppm
- oxygen concentration in the hot duct below 3%
- scrubber differential pressure below 40 inches of water

Additional control room monitoring instrumentation includes:

- scrubber effluent PH
- rotary kiln crossover duct temp
- induction draft and forced fan amperage
- target wall temperature
- loadby refractory temperature
- instrument air pressure

The physical inspection of the incinerator was conducted on February 13, at approximately 1340 hours.

Two waste streams are generated from the incinerator operation. Kiln ash: This is a solid removed via a metal cart. The area where the cart is staged is a concrete pad with concrete walls. This pad slopes downward towards the incinerator to facilitate movement of the cart between the rotary kiln and the 30 cubic yard roll-off used for the storage of the kiln ash. Cracks were noted in this pad. The roll-off is located within a containment area approximately fifty feet north of the incinerator. The containment consists of a concrete pad (with sump) and concrete curbing. A sheet metal roof structure provides protection from rain water entering the containers. This area is sized to contain two roll-offs. At the time of the inspection, rain water was noticed in this containment area.

Scrubber Sludge: This is the solid generated from the scrubber water treatment system. Material is deposited in a 30 cubic yard dump trailer after the final treatment process (centrifugation). This containment area consists of a concrete pad concrete curbing and a sheet metal roof. Area provides storage for one trailer.

RES has ten surface impoundments (B-206, B-207 and 8 L-series lagoons) which are regulated under RCRA and subject to ground water monitoring requirements.

B-206: This is a concrete lined basin for equilization and preaeration of contaminated ground water. The holding capacity of this basin is approximately 475,000 gallons.

B-207: This is an asphalt lined basin for the activated sludge treatment of contaminated water received from B-206. The holding capacity of this basin is approximately 240,000 gallons.

L-series lagoons: These are a series of eight (8) unlined surface impoundments located along southwest border of the facility. These units receive scrubber water from the on-site scrubber wastewater treatment plant. All lagoons are interconnected to allow the water to pass from one to another for cooling. Prior to the installation of the scrubber water treatment system these lagoons were utilized for the settling of particulate matter. Now they serve only for cooling and storage; however, this water is still hazardous by definition. The clarified overflow from the ground water treatment system is discharged to L-311. Current regulations will require that these lagoons cease operation by November 8, 1988. The facility is replacing all the lagoons with above-ground tanks.

5. Waste Analysis Plan

The Waste Analysis Plan in use at RES at the time of the inspection pertains to only incoming waste streams (plan was amended on 2/19/83 to include outgoing waste streams).

Prior to accepting any hazardous waste for transportation, storage, or treatment, RES requires a completed waste data sheet from the generator. This data sheet includes the following information: heating valve, halogen content, pH, metals content, organic constituents, PCB's ash content, flash point sulphur, and viscosity.

The initial waste evaluation is repeated at least every two years or if the process or operation generating the waste has changed or if the incoming waste shipment does not match the waste description or manifest. If the generator is unable to provide the necessary data, RES will analyze a representative sample of the waste to obtain the information.

Based on the information contained in this waste data sheet, RES' Safety and Technical departments prepare a waste safety sheet. This is done for every waste stream prior to acceptance. This is an internal document which lists the chemicals in the wastestream along with information pertinent to its handling. Other information on this waste data sheet includes storage, treatment or incineration

methods required, associated hazards, limits of compatability, personnel protective equipment required, fire protection details, reactivity and spill response procedures. These waste safety sheets are available at all locations where the waste stream is handled. Each waste stream is assigned a RES designated code.

Upon arrival of the waste material at the facility and prior to unloading, the waste is sampled and analyzed. If the waste is within the contracted test parameters the chemist will establish a course of action for the disposal as per the waste safety sheet. Prior to discharging liquid waste, samples undergo additional compatability testing to insure that a reaction will not occur.

Additionally, all blends are checked for heating value (BTU), halogens, sulphur, metals, ash, pH, viscosity, and flashpoint. At the time of inspection, the waste analysis plan was not checked for compliance 40 CFR Part 268.

6. Closure Plan

The closure plan in place at RES at the time of the inspection was not adequate. The plan included procedures for the decontamination and removal of a trickling filter system and two neutralization tanks. These units are no longer on-site. The closure plan should be amended to reflect the present day situation. As noted previously in this report, cracks were noticed in Drum Pad # 2's concrete pad and the concrete pad under the kiln ash cart area. A soil sampling plan which includes these areas should be part of the closure plan. The general decontamination procedures specified in the closure plan should include adequate information to insure complete decontamination.

APPENDICES

APPENDIX A

Tables of Schedule of Task Force Sampling Activities,
Physical Characteristics of Ground Water Monitoring
Wells, and Task Force Sampling Data

Table A-1

Outline of Ground Water Monitoring Activities Conducted by Task Force

<u>Date</u>	<u>Well</u>	<u>Activity</u>
2/9		Water level measurements taken. Equipment preparation.
2/10	Well AV-2	purged/sampled/trip Blank
	Well S	purged/sampled
	Well MA-3S	purged/sampled
	Well 29	purged/sampled/field blank
2/11	Well MA-9S	purged/sampled/field blank
	Well 17	purged/sampled
	Well MW-4A	purged/sampled/duplicate
2/12	Well MA-2D	purged/sampled/matrix spike
	Well MA-2S	purged/sampled/field blank
	25	purged/sampled
2/13	21A	purged/sampled
	W27	purged/sampled/Field Blank
2/16	DP-2	purged/sampled/matrix spike/field blank
	MA-8D	purged/sampled/equipment blank
2/17	W24	purged/sampled/equipment blank
	DP-5	purged/sampled/field blank
2/18	W29	purged/sampled/field blank
	MA-11D	purged/sampled
	MA-1S	purged/sampled
2/19	DP-1	purged/sampled/field blank
	L-2	purged/sampled
		Water level measurements taken.
2/20		Closeout meeting with Rollins Environmental Services

Table A-2

Summary of Analytical Parameters Sampled by The Task Force at RES

<u>Analysis</u>	<u>Bottle</u>	<u>Preservation Code</u>	<u>Bottles</u>
Volatile Organics (VOA) Purge and Trap	40 ml VOA Vials	1	2
Purgeable Organic Carbon (POC)	40 ml VOA Vials	1	1
Purgeable Organic Halogens (POX)	40 ml VOA Vials	1	1
Total Organic Carbon (TOC)	40 oz Wide Mouth Glass	1	1
Total Organic Halogens(TOX)	1 liter Amber Glass	1	1
Extractable Organics	1 liter Amber Glass	1	6
a) Acid, Base, Neutral			
b) Pesticides/PCB			
c) Herbicides			
Dioxin/Furans	1 liter Amber Glass	1	2
Total Metals	1 liter Plastic	3	1
Dissolved Metals	1 liter Plastic	3	1
Phenols	1 liter Amber Glass	2	1
Cyanide	1 liter Plastic	4	1
Anions	40 oz. Wide Mouth Glas	6	1
Sulfide	1 liter Plastic	5	1

Preservation Methods

- 1) Ice
- 2) H_2SO_4 <2
- 3) HNO_3 <2
- 4) NaOH >10
- 5) Zinc acetate followed by NaOH>10
- 6) Unpreserved except for samples containing sulfides,* if so add lead acetate until all lead sulfide has precipitated, filter out precipitate and preserve sample with acetic acid.

* Test for sulfides with lead acetate paper wetted with acetic acid.

Table A-3 Well Construction Details for Wells at Rollins Environmental Services (NJ), Inc., Logan Township, New Jersey. (From Geraghty & Miller)

Well No.	Permit Number	Screened Interval		Height of Measuring Point (feet above land surface)	Elevation of Measuring Point (feet relative to mean sea level)	Casing Diameter (inches)
		(feet below land surface)	(feet relative to mean sea level)			
Water-Table Aquifer						
4a	*	18.5 to 14	-	-	*	2
13	F30-8	8 to 26	1 to -17	3.26	12.65	4
14	F30-9	7 to 22	2 to -13	1.26	10.09	4
15	F30-10	12 to 26	- 3 to -17	2.48	11.57	4
16**	F30-11	8 to 23	- 2 to -17	2.79	9.29	4
17	F30-12	11 to 25	- 4 to -18	2.85	9.84	4
20A	F30-14	3 to 13	-	0.0	-	4
20B	F30-15	15 to 25	-11 to -21	0.0	4.17	4
21a	30-2834	10 to 25	- 4.1 to -19.1	1	6.93	6
22	30-1305	9.7 to 19.7	- 4.1 to -14.1	0.0	5.63	4
23b	*	*	*	*	*	*
24	30-1301	9.7 to 19.7	- 5.4 to -15.4	0.0	4.30	4
25	30-1303	9.7 to 19.7	- 5.8 to -15.8	0.0	3.44	4
26	F30-21	15 to 25	- 8 to -18	0.0	7.48	4
27	F30-22	15 to 25	- 8 to -18	0.0	6.78	4
28	F30-23	15 to 25	- 7 to -17	0.0	7.77	4
29	F30-24	15 to 25	-10 to -20	0.0	5.43	4
30S	30-2631	10 to 40	- 7 to -37.7	1.97	4.23	6
30D	30-2632	40 to 70	-37.9 to -67.9	1.94	3.95	6
31S	30-2633	10 to 40	- 4.4 to -34.4	0.97	6.53	6
31D	30-2634	40 to 70	-34.4 to -64.4	1.88	7.52	6
32S	30-2635	10 to 40	- 6.5 to -36.5	1.33	4.83	6
32D	30-2636	40 to 70	-36.4 to -66.4	1.28	4.91	6

* Data to be obtained

** Bent at an angle

Table A-3 (Continued)

Well No.	Permit Number	Screened Interval		(feet relative to mean sea level)	Height of Measuring Point (feet above land surface)	Elevation of Measuring Point (feet relative to mean sea level)	Casing Diameter (inches)
		(feet below land surface)					
33S	30-2637	10	to 40	- 4.8 to -34.8	2.35	7.56	6
33D	30-2638	40	to 70	-34.6 to -64.6	1.93	7.34	6
34S	30-2842	20	to 40	-16.2 to -36.2	2	5.81	6
34D	30-2841	40	to 63	-37.1 to -60.1	2	4.89	6
35S	30-2840	12	to 40	- 8.9 to -36.9	3	6.10	6
20b-1	30-2683	10	to 13	-	-	6.51	1.25
21-1	30-2684	13.5	to 16.5	-	-	7.09	1.25
22-1	30-2685	19.5	to 30	-	-	7.52	1.25
23-1	30-2686	12.5	to 15.5	-	-	9.10	1.25
24-1	30-2696	18	to 28	-	-	7.42	1.25
25-1	30-2695	18	to 28	-	-	7.03	1.25
322	30-2433	5	to 25	3 to -16	2.23	10.53	2
322-1	30-2513	2	to 22	5 to -15	2.20	9.07	2
B	F30-25	24	to 29	-16 to -21	1.32	9.01	2.5
C	F30-26	30	to 35	-20 to -25	0.0	9.55	2.5
E	F30-27	18	to 20	-	-	4.88	2.5
L	30-2481	5	to 15	-	-	6.33	2
R	F30-33	18.9	to 21.4	-14 to -16	1.79	6.74	2.5
S	F30-34	27	to 29.5	-22 to -24.5	2.59	7.56	2.5
T	F30-35	14.4	to 16.9	- 7.1 to - 9.6	1.70	8.99	2.5
U	F30-36	19.7	to 22.2	2.4 to - 0.1	-0.10	22.01	3
W	F30-38	19.9	to 22.4	-11.3 to -13.8	2.07	10.72	2.5
Y**	F30-81	10	to 12	- 8 to -10	2.97	5.33	1.25
H2	F30-66	7.3	to 9.3	- 0.5 to - 2.5	2.11	8.94	1.25
H3a	*	12.5	to 14.5	- 5.6 to - 7.7	2.65	*	1.25
H4a	30-3407	14	to 19	-	2.14	9.16	2

* Data to be obtained

** Bent at an angle

Table A-3 (Continued)

Well No.	Permit Number	Screened Interval		Height of Measuring Point (feet above land surface)	Elevation of Measuring Point (feet relative to mean sea level)	Casing Diameter (inches)
		(feet below land surface)	(feet relative to mean sea level)			
K1	F30-30	8.4 to 10.4	0.5 to - 1.5	1.68	10.59	1.25
K2	F30-69	14.3 to 16.3	- 5.7 to - 7.7	2.14	10.75	1.25
P4	F30-80	17.5 to 19.5	- 9 to -11	1.71	10.24	1.25
W15a	*	6.8 to 16.8	4.7 to - 5.3	3.68	*	1.25
W17	F30-63	9.9 to 19.9	- 0.9 to -10.9	3.66	12.71	1.25
W18	F30-64	10.1 to 20.1	2.9 to - 7.1	3.25	16.20	1.25
W19	F30-65	10.1 to 20.1	6.8 to - 3.2	0.42	17.34	1.25
W20	30-2518	6.5 to 11.5	- 5.6 to -10.6	2.00	2.89	2
W21	30-2519	19 to 24	-18 to -23	1.93	2.98	2
W22	30-2520	8.5 to 13.5	- 7.9 to -12.9	2.68	3.33	2
W23	30-2521	19 to 24	-19 to -24	2.67	3.14	2
W24	*	*	*	*	*	*
W25	*	*	*	*	*	*
W26	*	*	*	*	*	*
W27	*	*	*	*	*	*
W28	*	*	*	*	*	*
W29	*	*	*	*	*	*
W30	*	*	*	*	*	*
W31	*	*	*	*	*	*
X1	F30-70	10 to 12	-	-	5.09	1.25
X2	F30-71	4.9 to 6.9	-	-	6.04	1.25
AA	F30-72	-	-	3.63	5.42	1.25
BBa	*	*	*	*	*	*
CC	F30-39	18 to 20	-12 to -14	1.35	7.51	2
DD	F30-40	15 to 19	1 to - 3	1.00	16.53	2

* Data to be obtained

Table A-3 (Continued)

Well No.	Permit Number	Screened Interval		Height of Measuring Point (feet above land surface)	Elevation of Measuring Point (feet relative to mean sea level)	Casing Diameter (inches)
		(feet below land surface)	(feet relative to mean sea level)			
FF	F30-74	16.9 to 19.9	-	-	6.67	1.25
GG	F30-75	10.7 to 13.7	- 2.3 to - 5.3	2.66	11.07	1.25
HH	F30-77	3.6 to 6.6	-	-	5.08	1.25
II	F30-43	3 to 37.5	4.9 to -29.6	1.97	9.88	2
AV2	30-2515	13 to 23	5 to - 5	2.10	20.31	2
MA1S	30-2484	5 to 10	- 3 to - 8	0.85	2.53	2
MA1I	30-2483	25 to 35	-23 to -33	3.17	4.84	2
MA1D	30-2482	57 to 67	-55 to -65	3.46	5.10	2
MA2S	30-2487	5 to 10	- 3 to - 8	1.35	3.23	1.25
MA2I	30-2486	25 to 35	-23 to -33	1.17	3.24	1.25
MA2D	30-2485	59 to 69	-57 to -67	3.00	5.10	1.25
MA3S	30-2608	5 to 10	- 2 to - 7	1.18	4.28	2
MA3I	30-2607	30 to 40	-27 to -37	1.75	4.89	2
MA3D	30-2606	45 to 60	-42 to -57	1.58	4.23	2
MA4S	30-2611	10 to 15	- 5 to -10	2.89	7.77	2
MA4I	30-2610	35 to 50	-30 to -45	2.75	7.67	2
MA4D	30-2609	60 to 70	-55 to -65	2.60	7.40	2
MA5S	30-2490	5 to 10	- 3 to - 8	1.58	4.01	1.25
MA5I	30-2489	27 to 37	-25 to -35	1.55	4.03	1.25
MA5D	30-2488	50 to 60	-48 to -58	1.93	4.38	1.25
MA6S	30-2493	6 to 11	- 4 to - 9	1.80	3.78	1.25
MA6I	30-2492	11 to 21	- 9 to -19	1.70	3.76	1.25
MA6D	30-2491	49 to 59	-47 to -57	1.86	3.82	1.25
MA7S	30-2496	15 to 20	-13 to -18	1.37	2.89	1.25
MA7I	30-2495	24 to 34	-22 to -32	1.32	2.92	1.25
MA7D	30-2494	52 to 62	-51 to -61	1.40	2.73	1.25
MA8S	30-2499	8.5 to 13.5	- 6.7 to -11.7	1.55	3.39	1.25
MA8I	30-2498	25 to 35	-23 to -33	1.00	2.89	1.25
MA8D	30-2497	39 to 49	-37 to -47	1.07	2.60	1.25

Table A-3 (Continued)

Well No.	Permit Number	Screened Interval		Height of Measuring Point (feet above land surface)	Elevation of Measuring Point (feet relative to mean sea level)	Casing Diameter (inches)
		(feet below land surface)	(feet relative to mean sea level)			
MA9S	30-2507	7.5 to 12.5	- 4.9 to - 9.9	2.37	5.02	1.25
MA9I	30-2506	19 to 29	-16 to - 26	0.75	3.30	1.25
MA9D	30-2500	59 to 69	-57 to - 67	0.95	3.23	1.25
MA10S	30-2510	5 to 10	- 4 to - 9	1.50	2.38	1.25
MA10I	30-2509	19 to 29	-18 to - 28	1.05	1.99	1.25
MA10D	30-2508	49 to 59	-48 to - 58	1.90	2.98	1.25
MA11S	30-2573	5 to 10	- 4 to - 9	2.17	3.39	1.25
MA11I	30-2512	19 to 29	-18 to - 28	1.75	2.97	1.25
MA11D	30-2511	45 to 55	-44 to - 54	1.70	3.01	1.25
MW1a	*	1 to 26	5 to - 20	1.85	*	2
MW2a	30-3408	2 to 20	-	1.69	7.75	2
MW3a	30-3409	2 to 20	-	2.78	10.02	2
MW4a	*	1 to 21	8 to - 12	0.80	*	2
MW5	30-2438	3 to 28	6 to - 19	1.00	9.52	2
MW6	30-2439	1 to 29	7 to - 21	1.80	9.59	2
MW7	30-2697	20 to 30	-	-	10.67	1.25
DP1	30-1472	80 to 90	-75 to - 85	2.48	7.58	4
DP2	30-1471	80 to 90	-72 to - 82	2.13	10.62	4
DP3	F30-44	75 to 85	-53 to - 63	0.05	22.05	4
DP4***	30-2539	95 to 125	-83 to -113	1.53	13.13	8
DP5	30-2522	78.5 to 88.5	-71 to - 81	1.63	9.13	6

Note: Wells DP1, DP2, DP3, DP4, and DP5 are screened in the shallow artesian aquifer

* Data to be obtained

*** Screen diameter = 6 inches

Table A-4

Water Level Measurements Taken by the Task Force at RES

Well No.	Static 2/19/87	True Water Level	Static 2/9/87	True Water Level	Static Sampling	True Water Level	Sampling Date
II	DRY	----	-----	----	-----	----	----
DP-4	9.98	3.15	9.69 ^a	3.44	-----	----	----
AV-2 ^b	15.94	4.37	15.77 ^a	4.54	15.81	4.50	2/10
DP-3	19.15	2.90	19.89 ^a	2.16	-----	----	----
S	5.85	1.71	5.99 ^a	1.57	5.44	2.12	2/10
P-4	8.27	1.97	9.07 ^a	1.17	-----	----	----
MW-1A	-----	----	4.20 ^a	*	-----	----	----
DP-5	-----	----	7.10 ^a	2.03	7.41	1.72	2/17
W29	7.90	2.43	7.23 ^a	3.10	7.43	2.90	2/18
W30	8.09	2.43	-----	----	-----	----	----
W31	8.33	4.06	7.93 ^a	4.46	-----	----	----
W28	7.96	2.93	-----	----	-----	----	----
14	7.74	2.35	-----	----	-----	----	----
W15A	11.71	*	11.42 ^a	*	-----	----	----
322	8.67	1.86	8.17 ^a	2.36	-----	----	----
21A	4.73	2.20	-----	----	4.42	2.51	2/13
MW-2A	5.46	2.29	5.57 ^a	2.18	-----	----	----
22	3.73	1.9	-----	----	-----	----	----
W27	4.55	1.96	4.10	2.41	4.10	2.41	2/13
23b	6.57	*	-----	----	-----	----	----
W24	7.27	1.76	6.10 ^a	2.43	7.14	1.89	2/17
W25	11.83	1.94	12.75 ^a	1.02	-----	----	----
13	10.68	1.97	-----	----	-----	----	----
MW-3A	7.34	2.68	-----	----	-----	----	----
24	2.62	1.68	-----	----	-----	----	----
17	7.91	1.93	8.70 ^a	1.14	7.49	2.35	2/11
MA-7S	1.99	0.90	2.29	0.6	-----	----	----
MA-7D	1.82	0.91	1.21	1.52	-----	----	----
MA-2S	-----	----	1.75	1.48	1.75	1.48	2/12
MA-2D	3.42	1.68	2.50	2.6	2.56	2.54	2/12
MA-3S	4.36	-.08	3.79	0.49	3.74	0.54	2/10
MA-3D	2.80	1.43	2.21	2.02	-----	----	----
29	3.82	1.61	3.46	1.97	3.37	2.06	2/10
MA-1D	2.78	2.32	2.54	2.56	-----	----	----
MA-1S	1.31	1.22	1.08	1.45	1.11	1.42	2/18
4A	2.60	*	2.29	*	-----	----	----

Measurements taken to top of PVC (inner) casing unless otherwise qualified

a - Measurements taken by Alliance to top of protective casing

b - Upgradient well

* - data to be obtained

Table A-4 (Cont.)

Water Level Measurements Taken by the Task Force at RES

Well No.	Static 2/19/87	True Water Level	Static 2/9/87	True Water Level	Static Sampling	True Water Level	Sampling Date
28	6.38	1.39	6.29	1.48	-----	-----	-----
MA-8S	2.81	0.58	2.87	.52	-----	-----	-----
MA-8D	1.55	1.05	1.71	0.89	1.87	0.73	2/16
MA-4S	6.64	1.13	7.23	0.54	-----	-----	-----
MA-4D	6.15	1.25	8.92		-----	-----	-----
MA-9S	3.79	1.23	5.00	0.02	4.59	0.43	2/11
MA-9D	3.74	-.51	5.40	-2.17	-----	-----	-----
MW-6	7.89	1.70	-----	-----	-----	-----	-----
R	4.30	2.44	-----	-----	-----	-----	-----
25	Pumping	----	4.02	-.58	3.52	-.08	2/12
MW-4A	8.73	*	6.97-	*	6.90	*	2/11
MW-7	9.19	1.48	10.33	0.34	-----	-----	-----
26	6.08	1.40	7.88	-.4	-----	-----	-----
MA-11I	-----	-----	1.81	1.16	-----	-----	-----
MA-11D	-----	-----	0.80	2.21	1.79	1.22	2/18
DP-2	-----	-----	11.21	-.59	10.25	.37	2/16
DP-1	-----	-----	-----	-----	6.65	.93	2/19
L-2	-----	-----	-----	-----	6.20		2/19

Measurements taken to top of PVC (inner) casing unless otherwise specified

a - Measurements taken by Alliance to top of protective casing

b - Upgradient well

* - data to be obtained

Table A-5

Duplicate Water Level Measurements Taken by the Task Force

Well Number	Depth to Water(ft.)		Depth to Water Difference (ft.)	Total Depth(ft.)		Total Depth Difference (ft.)	Time Between Measurements	Date
	1	2		1	2			
MA-2S ^a	1.75	1.75	0.00	8.73	8.73	0.00	Immediate	2/9/87
4A ^a	2.3	2.25	0.50	19.04	19.08	0.04	"	2/9/87
MA-8D ^a	1.73	1.71	0.02	49.83	49.81	0.02	"	2/9/87
26 ^a	8.21	7.875	0.335	24.75	24.79	0.04	"	2/9/87
MW-24 ^b	6.91	6.90	0.01	--	--	--	"	2/9/87
322 ^b	--	--	--	26.77	26.66	0.11	"	2/9/87
322 ^c	8.67	8.67	0.00	--	--	--	"	2/19/87
17 ^c	7.91	7.91	0.00	--	--	--	"	2/19/87

-- - No duplicate measurements taken

- a - Distance measured in feet from top of casing. Team: DiGuardia/DeLuca
- b - Distance measured in feet from top of protective casing. Team: Lewis/Naughton
- c - Distance measured in feet from top of casing. Team: DiGuardia/Lewis/Naughton

Table A-6

Physical Characteristics of Wells Measured and Sampled by Task Force at Rollins Environmental Services

Well No.	Total Depth (ft.)	Static Water Level (ft.)	Casing Diameter (in.)	Volume in column (gal.)	Volume Purged (gal.)
* AV-2	22.9	15.81	2	1.2	3.8
S	29.78	5.44	4	9.0	27.0
MA-3S	13.29	3.74	2	1.6	5.0
* 29	25.0	3.37	4	14.0	56.0
MA-9S	13.69	4.59	1.25	.59	2.0
17	20.64	7.49	4	8.5	26.0
MW-4A	24.25	6.90	2	2.85	9.0
MA-20	67.70	2.56	1.25	5.97	18.0
MA-2S	8.75	1.75	1.25	.65	2.0
25	19.70	3.52	4	10.08	42.0
* 21A	25.00	4.42	6	30.20	94.0
W27	24.85	4.10	4	13.4	45.0
DP-2	89.53	10.25	4	50.8	155.0
MA-8D	49.02	1.87	1.25	4.8	15.0
W-24	25.48	7.14	4	12.0	38.0
DP-5	88.43	7.41	6	116.0	360.0
W-29	26.64	7.43	4	12.5	38.0
MA-11D	55.25	1.79	1.25	5.45	16.5
MA-1S	13.93	1.11	2	2.1	7.0
DP-1	93.56	6.65	4	55	170.0
L-2	14.51	6.20	4	5.4	16.25

* Upgradient

* Abatement Well - no total depth

+ All measurements taken from top of casing

Table A-7

Results of Air Monitoring at Ground Water Monitoring Wells Sampled by the Task Force at RES

Well Number	OVA Readings (ppm)		HNU Readings (ppm)		Geiger Readings (mrems/hr)		Interface Probe
	background	well	background	well	background	well	
AV-2	*	*	0.3	0.3	0.02	0.02	Neg.
S	*	*	0.4	0.4	0.02	0.02	Neg.
MA-3S	*	*	0.4	13.0	0.02	0.02	Neg.
29	*	*	0.4	0.4	0.02	0.02	Neg.
MA-9S	*	*	0.4	1.2	0.02	0.02	Neg.
17	*	*	0.4	0.5	0.02	0.02	Neg.
MW-4A	*	*	0.4	0.4	0.02	0.02	Neg.
MA-2D	*	*	0.4	40.0+	0.02	0.02	Neg.
MA-2S	*	*	0.4	0.4	0.02		Neg.
25	3.5	18	0.2	0.2	0.02	0.02	Neg.
21A	2.0	2.0	0.4	0.5	0.02	0.02	Neg.
W27	4.0	>100.0+	0.4	0.4	0.02	0.02	Neg.
DP-2	5.0	5.0	0.5	0.5	0.02	0.02	Neg.
MA-8D	4.0	4.0	0.4	0.8	0.02	0.02	Neg.
W24	*	*	0.2	0.7	0.02	0.02	Neg.
DP-5	*	*	0.3	0.3	0.02	0.02	Neg.
W29	*	*	0.2	0.3	0.02	0.02	Neg.
MA-11D	*	*	0.3	0.3	0.02	0.02	Neg.
MA-1S	*	*	0.4	20.0+	0.02	0.02	Neg.
DP-1	*	*	0.6	0.6	0.02	0.02	Neg.
L-2	*	*	0.4	6.0	0.02	0.02	Neg.

* OVA not operational

+ Reading obtained upon purging well

Table A-8

Field Measurements Conducted by the Task Force at RES

Sample Location	Temperature (C°)	pH (S.U.)	Specific Conductivity	Turbidity (NTU)
AV-2	11.2	6.1	250	6.2
S	12.9	4.5	500	20
MA-3S	10.1	5.2	650	15
29	14.5	6.0	1200	30
MA-9S	11.0	5.6	300	>100
17	9.8	6.3	475	42
MW-4A	7.2	6.8	260	>100
MA-2D	12.3	6.9	11600	NA
MA-2S	10.1	6.1	1300	>100
25	12.9	6.7	10500	>100
21A	15.0	6.2	5250	20
W27	11.0	6.8	3250	>100
DP-2	13.8	4.7	230	NA
MA-8D	11.2	6.2	480	NA
W24	13.0	6.9	3000	NA
DP-5	11.9	4.1	575	NA
W29	7.8	6.4	540	NA
MA-11D	11.2	6.0	340	NA
MA-1S	12.0	6.3	1225	NA
DP-1	9.7	6.3	330	NA
L-2	13.7	6.3	2750	NA

NA - Not analyzed

Key to Results of Sample Analysis

- J - Compound present below the specified detection limit
- N - Indicates spike sample recovery is not within control limits
- * - Indicates duplicate analysis is not within control limits
- S - Indicates value determined by Method of Standard Addition
- U - Compound was analyzed but not detected
- () - If the result is a value greater than or equal to the instrument detection limit but less than the contract required detection limit
- - data did not pass QA/QC review

Table A-9 Results of Inorganic and Indicator Type Analyses

Water Table Aquifer

Parameter mg/l	MA-8D MQB-003	MA-3S MQB-005	29 MQB-006	MA-2S MQB-007	S MQB-008	MA-9S MQB-009	AV-2 MQB-010	W-29 MQB-011 (DUP)	MA-2D MQB-012
Bromide	U	U	2.3	U	U	U	U	U	U
Chloride	35	126	153	195	24	33	4.5	23	1300
Fluoride	U	U	1.1	2.2	U	U	U	1.0	U
Sulfate	58	40	17	58	18	28	48	69	620

Parameter ug/l	MA-8D MQB-003	MA-3S MQB-005	29 MQB-006	MA-2S MQB-007	S MQB-008	MA-9S MQB-009	AV-2 MQB-010	W-29 MQB-011 (DUP)	MA-2D MQB-012
POC	980	3300	4540	76	U	78	224	1420	4400
TOC	1800	10000	42000	16000	1600	8000	1800	10000	204000
Phenols, total	U	U	888	U	U	U	U	U	888
POX	U	11	3330	U	U	18	U	6	11100
TOX	---	---	5380	---	---	---	---	---	4100

Table A-9 (Cont.) - Results of Inorganic and Indicator Type Analyses

Water Table Aquifer

Parameter mg/l	25 MQB-013	21A MQB-014	L-2 MQB-025	MW-4A MQA-736	W-29 MQA-739	MA-1S MQA-741	17 MQA-742	MW-4A MQA-743 (DUP)	MW-27 MQA-744
Bromide	U	30	25	U	U	11	U	U	5.3
Chloride	2250	1760	1160	21	22	298	43	40	760
Fluoride	U	13	14	2.1	U	16	1.6	1.5	6.9
Sulfate	2700	375	180	16	69	U	103	30	320

Parameter ug/l	25 MQB-013	21A MQB-014	L-2 MQB-025	MW-4A MQA-736	W-29 MQA-739	MA-1S MQA-741	17 MQA-742	MW-4A MQA-743 (DUP)	MW-27 MQA-744
POC	42	75	48	83	980	28000	1380	97	1400
TOC	16000	6200	9400	268000	10000	267000	13000	206000	9800
Phenols, total	U	U	U	U	U	5000	U	U	U
POX	26	14	U	U	U	7400	393	U	19
TOX	---	---	---	---	---	21300	574	---	---

Table A-9 (Cont.) - Results of Inorganic and Indicator Type Analyses

Water Table Aquifer

Parameter mg/l	W-24 MQA-745	MA-11D MQA-749
Bromide	4.5	U
Chloride	790	30
Fluoride	U	U
Sulfate	280	60

Shallow Artesian Aquifer

DP-2 MQB-004	DP-1 MQB-026	DP-5 MQA-750
U	U	U
32	75	68
U	U	U
12	9.2	112

Parameter ug/l	W-24 MQA-745	MA-11D MQB-749
POC	3000	1160
TOC	15000	1700
Phenols, total	U	U
POX	103	U
TOX	---	---

DP-2 MQB-004	DP-1 MQB-026	DP-5 MQA-750
26	44	280
U	U	3000
U	U	U
U	U	131
---	---	----

Table A-10 - Results of Total Metals Analyses

Water Table Aquifer

Parameter ug/l	MA-8D MQB-003	MA-3S MQB-005	29 MQB-006	MA-2S MQB-007	S MQB-008	MA-9S MQB-009	AV-2 MQB-010	W-29 MQB-011 (DUP)
Aluminum	1770*	28500*	447*	30200*	661*	7160*	55400*	1620*
Antimony	U	U	U	U	U	U	U	U
Arsenic	U*	(7.8)*	57*S	13*S	U*	U*	18*	23*S
Barium	(116)N	(137)N	(50)N	208N	(78)N	(46)N	274N	(59)N
Beryllium	U	(2)	U	(2)	U	U	(3)	U
Cadmium	UN	UN	UN	(.6)N	---	(.6)N	---	UN
Calcium	35300	33600	50300	36600	24600	42000	12900	56200
Chromium	U	120	20	65	U	25	163	22
Cobalt	(22)	U	U	(20)	U	U	21	U
Copper	(24)	89	26	(24)	48	40	191	69
Iron	2580N	30100N	17500N	40200N	1510N	31700N	61100N	21400N
Lead	5.6N	19N	UN	31N	(4.1)N	25N	26NS	17NS
Magnesium	15900N	14300N	18300N	23400N	20400N	7260N	7950N	28500N
Manganese	596	198	1340	791	228	539	669	751
Mercury	UN	2.1N	UN	.3N	UN	3.7N	UN	UN
Nickel	(29)	(29)	U	(30)	U	(26)	(26)	U
Potassium	12300	(4190)	8200	6220	(4220)	6630	18600	5230
Selenium	UN	UN	UN	UN	UN	UN	UN	UN
Silver	U	U	U	U	U	U	U	U
Sodium	18400	54000	77100	93100	7680	11600	(3070)	21300
Thallium	UN	UN	UN	UN	UN	UN	UN	UN
Tin	U	U	U	U	U	U	U	U
Vanadium	U	136	(17)	(42)	U	304	403	U
Zinc	123	69	43	93	82	59	97	43
Cyanide	---	UN	UN	---	UN	UN	UN	UN
Cyanide(DUP)	NA	NA	NA	NA	NA	NA	NA	NA

Table A-10 (Cont.) - Results of Total Metals Analyses

Water Table Aquifer

Parameter ug/l	MA-2D MQB-012	25 MQB-013	21A MQB-014	L-2 MQB-025	MW-4A MQA-736	W-29 MQA-739	MA-1S MQA-741	17 MQA-742
Aluminum	8290*	5600*	1130	14000*	360000*	2770*	U*	7650*
Antimony	U	U	U	U	U	U	U	U
Arsenic	394*S	472*S	43*S	U*	U*	22*S	88*S	62*S
Barium	(52)N	(116)N	(68)N	(123)N	1040N	(45)N	(59)N	(106)N
Beryllium	U	(2)	U	U	25	U	U	(2)
Cadmium	UN	UN	UN	---	(2)N	UN	UN	(7.5)N
Calcium	145000	451000	306000	278000	58600	53600	6390	78400
Chromium	18	440	101	29	1640	19	U	7880
Cobalt	(27)	U	U	U	122	U	U	66
Copper	(16)	294	U	36	1680	61	U	4890
Iron	7990N	99700N	13900N	19900N	438000N	21400N	7200N	279000N
Lead	46NS	(26)N	6.5N	25N	51N	13N	21NS	130N
Magnesium	176000N	256000N	196000N	167000N	31900N	28000N	(2320)N	13700N
Manganese	287	719	98	475	2140	743	178	2040
Mercury	---	---	---	---	1.4N	UN	.3N	.4N
Nickel	167	U	U	U	184	U	U	153
Potassium	48300	17200	15100	11600	34900	5240	(2740)	13800
Selenium	UN	UN	UN	UN	UN	UN	UN	UN
Silver	U	U	U	U	U	U	U	U
Sodium	1710000	820000	482000	405000	7980	21100	71100	47400
Thallium	UN	UN	UN	UN	UN	UN	UN	UN
Tin	U	U	U	U	U	U	U	U
Vanadium	292	(22)	U	(38)	1100	U	U	(46)
Zinc	92	204	38	53	1280	31	(19)	1350
Cyanide	---	45	UN	UN	80	UN	UN	UN
Cyanide(DUP)	NA	50	NA	NA	87	NA	NA	NA

Table A-10 (Cont.) - Results of Total Metals Analyses

Water Table Aquifer

Parameter ug/l	MW-4A MQA-743 (DUP)	MW-27 MQA-744	W-24 MQA-745	MA-11D MQA-749
Aluminum	215000*	5350*	1570*	17700*
Antimony	U	---	U	U
Arsenic	(8.1)*	27*	U*	U*
Barium	715N	(69)N	(32)N	(125)N
Beryllium	17	U	U	5
Cadmium	(1.1)N	UN	UN	UN
Calcium	51000	201000	218000	36200
Chromium	1230	U	U	71
Cobalt	83	U	(20)	(30)
Copper	1230	150	(12)	141
Iron	293000N	13600N	50400N	13300N
Lead	192N	24N	29N	23NS
Magnesium	22300N	145000N	89400N	19100N
Manganese	1600	604	1900	459
Mercury	1N	UN	UN	UN
Nickel	118	U	U	(26)
Potassium	22400	10000	11800	14000
Selenium	UN	UN	UN	UN
Silver	U	U	U	U
Sodium	7610	295000	222000	6410
Thallium	UN	UN	UN	UN
Tin	U	U	U	U
Vanadium	754	U	U	(37)
Zinc	886	78	29	168
Cyanide	40	UN	UN	UN
Cyanide(DUP)	40	NA	NA	NA

Shallow Artesian Zone

DP-2 MQB-004	DP-1 MQB-026	DP-5 MQA-750
322*	(190)*	1840*
U	U	U
U*	U*	U*
(105)N	(58)N	(79)N
U	U	U
(3.2)N	UN	UN
6880	5740	16800
U	U	U
U	U	(20)
(14)	U	28
386N	7250N	538N
14N	16N	10N
(2780)N	(2100)N	18500N
116	176	69
UN	UN	UN
U	U	U
(2320)	(2520)	5550
UN	UN	UN
U	U	U
18700	61500	56200
UN	UN	UN
U	U	U
U	U	U
36	34	59
UN	UN	UN
NA	NA	NA

Table A-11 - Results of Dissolved Metals Analyses

Water Table Aquifer

Parameter ug/l	MA-8D MQB-003	MA-3S MQB-005	29 MQB-006	MA-2S MQB-007	S MQB-008	MA-9S MQB-009	AV-2 MQB-010	W-29 MQB-011 (DUP)
Aluminum	(44)	(49)	(72)	(55)	434	(52)	U	U
Antimony	U	U	U	U	U	U	U	U
Arsenic	UN	UN	52NS	UN	UN	UN	UN	(7.5)NS
Barium	(119)	(61)	(39)	(101)	(75)	(44)	(62)	(52)
Beryllium	U	U	U	U	U	U	U	U
Cadmium	U	U	U	U	U	U	(1.4)	6.9
Calcium	37800	32700	53500	36600	26100	44200	11000	60700
Chromium	U	U	U	U	U	U	U	U
Cobalt	(35)	U	U	U	U	U	U	U
Copper	UN	(8)N	UN	UN	52N	UN	UN	UN
Iron	920	2120	11400	13100	U	89	3870	19000
Lead	UN	UN	UN	40N	5.4N	UN	5.3N	UN
Magnesium	17800	12200	20200	22500	22500	7880	5640	32100
Manganese	656	136	1450	715	216	503	491	831
Mercury	UN	UN	UN	UN	UN	UN	UN	UN
Nickel	U	U	U	U	U	U	U	U
Potassium	15000	(3360)	9330	5810	5120	7510	18800	5710
Selenium	UN	UN	---	UN	UN	UN	UN	UN
Silver	U	U	U	U	U	U	U	U
Sodium	20600	55100	84600	107000	8450	13800	(3020)	24100
Thallium	UN	UN	UN	UN	UN	UN	UN	UN
Tin	(40)	U	U	U	U	U	U	U
Vanadium	(14)	U	(15)	U	U	U	U	U
Zinc	162	30	(17)	25	110	50	29	(19)

Table A-11 (Cont.) - Results of Dissolved Metals Analyses

Water Table Aquifer

Parameter ug/l	MA-2D MQB-012	25 MQB-013	21A MQB-014	L-2 MQB-025	MW-4A MQA-736	W-29 MQA-739	MA-1S MQA-741	17 MQA-742
Aluminum	(44)	(142)	820	245	(60)	U	U	280
Antimony	U	U	U	U	U	U	U	U
Arsenic	264NS	56NS	UN	UN	UN	---	---	UN
Barium	(54)	(88)	(74)	(87)	(48)	(52)	(121)	(31)
Beryllium	U	U	U	U	U	U	U	U
Cadmium	U	U	U	U	U	U	U	U
Calcium	155000	515000	358000	284000	37500	58600	57400	70000
Chromium	U	U	U	U	U	U	U	U
Cobalt	U	U	U	U	U	U	U	U
Copper	UN	(11)N	UN	UN	UN	UN	UN	UN
Iron	238	11300	3310	4640	U	16600	151000	11700
Lead	UN	UN	UN	UN	UN	UN	UN	(2.4)N
Magnesium	196000	299000	236000	170000	6170	30500	13400	12700
Manganese	296	773	121	429	35	779	2440	1040
Mercury	---	---	---	---	UN	UN	UN	UN
Nickel	150	U	U	U	U	U	U	U
Potassium	54400	19700	18800	9530	5290	5480	11700	13100
Selenium	---	UN	UN	UN	UN	UN	UN	UN
Silver	U	U	U	U	U	U	U	U
Sodium	1570000	738000	579000	421000	9270	22500	132000	32000
Thallium	UN	UN	UN	UN	UN	UN	UN	UN
Tin	U	U	U	U	U	(38)	U	U
Vanadium	311	(15)	U	U	U	U	U	U
Zinc	31	55	(16)	21	U	(19)	41	92

Table A-11 (Cont.) - Results of Dissolved Metals Analyses

Water Table Aquifer

Parameter ug/l	MW-4A MQA-743 (DUP)	MW-27 MQA-744	W-24 MQA-745	MA-11D MQA-749
Aluminum	339	(187)	U	620
Antimony	U	U	U	U
Arsenic	UN	20N	UN	UN
Barium	(61)	(49)	(32)	(86)
Beryllium	U	U	U	(3)
Cadmium	U	U	U	(1)
Calcium	37100	221000	236000	34900
Chromium	U	U	U	U
Cobalt	U	U	U	(21)
Copper	UN	UN	UN	74N
Iron	(98)	7820	40300	(41)
Lead	UN	UN	UN	UN
Magnesium	5960	161000	102000	16800
Manganese	47	628	2150	368
Mercury	UN	UN	UN	UN
Nickel	U	U	U	U
Potassium	5460	12200	14300	13100
Selenium	UN	UN	UN	UN
Silver	U	U	U	U
Sodium	8620	315000	244000	5700
Thallium	UN	UN	UN	UN
Tin	U	U	U	U
Vanadium	U	U	U	U
Zinc	28	29	36	124

Shallow Artesian Zone

DP-2 MQB-004	DP-1 MQB-026	DP-5 MQA-750
U	U	456
U	U	U
UN	UN	UN
(113)	(59)	(100)
U	U	U
(2.5)	U	U
7600	6440	18200
U	U	U
U	U	(25)
(11)N	UN	(21)N
(27)	7270	(84)
12N	UN	28N
(3230)	(2380)	21000
129	178	76
UN	UN	UN
U	U	U
(3070)	(2600)	6670
UN	UN	UN
U	U	U
20400	70700	62700
UN	UN	UN
U	53	U
U	U	U
50	U	110

Table A-12 - Results of Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	MA-8D MQB-003	MA-3S MQB-005	29 MQB-006	MA-2S MQB-007	S MQB-008	MA-9S MQB-009
Acetone	-----	-----	-----	-----	-----	-----
Benzene	U	U	530	U	U	U
2-Butanone	12	U	U	U	U	U
Carbon Disulfide	U	U	U	U	U	U
Carbon Tetrachloride	U	U	U	U	U	U
Chlorobenzene	U	U	69	U	U	U
Chloroform	U	U	440	U	2J	U
1,1-Dichloroethane	U	U	45J	U	U	U
1,2-Dichloroethane	U	U	120	U	U	U
1,2-Dichloropropane	6	U	U	U	U	U
Ethylbenzene	U	U	73	U	U	U
2-Hexanone	U	U	U	U	U	U
Methylene Chloride	-----	-----	-----	-----	-----	-----
Tetrachloroethene	U	U	27J	U	U	U
Trichloroethene	U	U	230	U	U	U
1,1,1-Trichloroethane	U	U	330	U	1J	U
Trans-1,2-Dichloroethene	U	U	51	U	U	26
Toluene	U	U	570	U	U	U
Total Xylene	U	U	190	U	U	U
Vinyl Chloride	U	U	35J	U	U	U
1,2-Dibromoethane	11	U	U	U	U	U
Trichlorofluoromethane	-----	-----	-----	-----	-----	-----

Table A-12 (Cont.) - Results of Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	AV-2 MQB-010	W29 MQB-011 (DUP)	MA-2D MQB-012	25 MQB-013	21A MQB-014	L-2 MQB-025
Acetone	-----	-----	-----	-----	-----	-----
Benzene	U	U	1800	U	U	U
2-Butanone	U	U	41J	U	U	U
Carbon Disulfide	U	U	990	U	U	U
Carbon Tetrachloride	U	U	U	U	U	U
Chlorobenzene	U	U	310	U	U	U
Chloroform	U	U	U	U	U	U
1,1-Dichloroethane	U	U	38J	U	U	U
1,2-Dichloroethane	U	U	U	U	U	U
1,2-Dichloropropane	U	U	U	U	U	U
Ethylbenzene	U	U	190J	U	U	U
2-Hexanone	U	U	U	U	U	U
Methylene Chloride	-----	-----	-----	-----	-----	-----
Tetrachloroethene	U	U	U	U	U	U
Trichloroethene	U	U	U	U	U	U
1,1,1-Trichloroethane	U	U	U	U	U	U
Trans-1,2-Dichloroethene	U	U	U	U	U	U
Toluene	U	2J	62J	U	2J	U
Total Xylene	U	U	610	U	U	U
Vinyl Chloride	U	U	U	U	U	U
1,2-Dibromoethane	U	U	U	U	U	U
Trichlorofluoromethane	-----	-----	-----	-----	-----	-----

Table A-12 (Cont.) - Results of Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	MW-4A MQA-736	W-29 MQA-739	MA-1S MQA-741	17 MQA-742	MW-4A MQA-743 (DUP)	MW-27 MQA-744
Acetone	-----	-----	-----	-----	-----	-----
Benzene	U	U	3100	16	U	3J
2-Butanone	U	U	1300	U	U	U
Carbon Disulfide	U	U	U	U	U	U
Carbon Tetrachloride	U	U	U	U	U	U
Chlorobenzene	U	U	360J	31	U	7
Chloroform	U	U	700	33	U	U
1,1-Dichloroethane	U	U	510	9	U	2J
1,2-Dichloroethane	20	U	300J	U	20	U
1,2-Dichloropropane	U	U	U	U	U	U
Ethylbenzene	U	U	720	8	U	1J
2-Hexanone	U	U	1100	U	U	U
Methylene Chloride	-----	-----	-----	-----	-----	-----
Tetrachloroethene	U	U	U	41	U	U
Trichloroethene	U	U	U	120	U	U
1,1,1-Trichloroethane	U	U	860	150	U	U
Trans-1,2-Dichloroethene	U	U	1600	12	U	3J
Toluene	U	U	10000	2J	U	U
Total Xylene	U	U	2800	U	U	U
Vinyl Chloride	U	U	1000	U	U	2J
1,2-Dibromoethane	U	U	U	U	U	U
Trichlorofluoromethane	-----	-----	-----	-----	-----	-----

Table A-12 (Cont.) - Results of Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	W-24 MQA-745	MA-11D MQA-749
Acetone	-----	-----
Benzene	38	U
2-Butanone	U	U
Carbon Disulfide	U	U
Carbon Tetrachloride	7	U
Chlorobenzene	13	U
Chloroform	4J	U
1,1-Dichloroethane	9	U
1,2-Dichloroethane	23	U
1,2-Dichloropropane	U	U
Ethylbenzene	6	U
2-Hexanone	U	U
Methylene Chloride	-----	-----
Tetrachloroethene	6	U
Trichloroethene	94	U
1,1,1-Trichloroethane	29	U
Trans-1,2-Dichloroethene	32	U
Toluene	4J	U
Total Xylene	9	U
Vinyl Chloride	16	U
1,2-Dibromoethane	U	U
Trichlorofluoromethane	-----	-----

Shallow Artesian Zone

DP-2 MQB-004	DP-1 MQB-026	DP-5 MQA-750
-----	-----	-----
U	U	7
U	U	U
U	U	U
U	U	1J
U	U	U
U	U	5
U	U	10
U	U	180
U	U	U
U	U	U
U	U	U
-----	-----	-----
U	U	2J
1J	U	20
U	U	U
U	U	4J
U	U	U
U	U	U
7J	1J	8J
U	U	U
-----	-----	-----

Table A-13 - Results of Semi-Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	MA-8D MQB-003	MA-3S MQB-005	29 MQB-006	MA-2S MQB-007	S MQB-008	MA-9S MQB-009
Acenaphthene	U	U	U	U	U	U
Benzoic Acid	U	U	340	U	U	U
Bis(2-chloroethyl)ether	U	U	200	U	U	U
Bis(2-ethylhexyl)phthalate	-----	-----	-----	-----	-----	-----
2-Chlorophenol	U	U	10	U	U	U
4-Chloroaniline	U	U	2000	U	U	U
1,2-Dichlorobenzene	U	U	38	U	U	U
1,3-Dichlorobenzene	U	U	4J	U	U	U
1,4-Dichlorobenzene	U	U	8J	U	U	U
2,4-Dichlorophenol	U	U	170	U	U	U
2,4-Dimethylphenol	U	U	180	U	U	U
2-Methylphenol	U	U	U	U	U	U
4-Methylphenol	-----	-----	-----	-----	-----	-----
2-Methylnaphthalene	U	U	47	U	U	U
Naphthalene	U	U	140	U	U	U
Phenol	U	U	370	U	1J	U
Phosphorictriamide,Hexamethyl	U	U	13	U	U	U
1,2,4-Trichlorobenzene	U	U	U	U	U	U
Acetophenone	U	U	410	U	U	U
Aniline	U	U	150	U	U	U
2-Hexanone	U	U	U	U	U	U
4-Methyl-2-Pentanone	U	U	U	U	U	U
Pyridine	U	U	U	U	U	U
O-Toluidine	U	U	960	U	U	U

Table A-13 (Cont.) - Results of Semi- Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	AV-2 MQB-010	W29 MQB-011 (DUP)	MA-2D MQB-012	25 MQB-013	21A MQB-014	L-2 MQB-025
Acenaphthene	U	U	U	U	U	U
Benzoic Acid	U	U	U	U	U	U
Bis(2-chloroethyl)ether	U	U	U	U	1J	U
Bis(2-ethylhexyl)phthalate	-----	-----	-----	-----	-----	-----
2-Chlorophenol	U	U	U	U	U	U
4-Chloroaniline	U	U	U	U	U	U
1,2-Dichlorobenzene	U	U	U	U	U	U
1,3-Dichlorobenzene	U	U	U	U	U	U
1,4-Dichlorobenzene	U	U	9J	U	U	U
2,4-Dichlorophenol	U	U	26J	U	U	U
2,4-Dimethylphenol	U	U	U	U	U	U
2-Methylphenol	U	U	11J	U	U	U
4-Methylphenol	-----	-----	-----	-----	-----	-----
2-Methylnaphthalene	U	U	U	U	U	U
Naphthalene	U	U	110	U	U	U
Phenol	U	U	380	U	U	2J
Phosphorictriamide,Hexamethyl	U	U	U	U	U	U
1,2,4-Trichlorobenzene	U	U	U	U	U	U
Acetophenone	U	U	U	U	U	U
Aniline	U	U	U	U	U	U
2-Hexanone	U	U	U	U	U	U
4-Methyl-2-Pentanone	U	U	U	U	U	U
Pyridine	U	U	U	U	U	U
O-Toluidine	U	U	U	U	U	U

Table A-13 (Cont.) - Results of Semi-Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	MW-4A MQA-736	W-29 MQA-739	MA-1S MQA-741	17 MQA-742	MW-4A MQA-743 (DUP)	MW-27 MQA-744
Acenaphthene	U	1J	U	U	U	U
Benzoic Acid	U	U	U	U	U	U
Bis(2-chloroethyl)ether	U	U	U	U	U	2 J
Bis(2-ethylhexyl)phthalate	-----	-----	-----	-----	-----	-----
2-Chlorophenol	U	U	U	U	U	U
4-Chloroaniline	U	U	27000	U	U	U
1,2-Dichlorobenzene	U	U	93	5J	U	U
1,3-Dichlorobenzene	U	U	U	U	U	5J
1,4-Dichlorobenzene	U	U	31J	U	U	U
2,4-Dichlorophenol	U	U	47	U	U	U
2,4-Dimethylphenol	U	U	970	U	U	U
2-Methylphenol	U	U	U	U	U	U
4-Methylphenol	-----	-----	-----	-----	-----	-----
2-Methylnaphthalene	U	U	100	U	U	U
Naphthalene	U	U	1000	U	U	U
Phenol	U	U	U	U	U	U
Phosphorictriamide,Hexamethyl	U	U	U	U	U	U
1,2,4-Trichlorobenzene	U	U	U	6J	U	U
Acetophenone	U	U	U	U	U	U
Aniline	U	U	1700	U	U	U
2-Hexanone	U	U	U	U	77	U
4-Methyl-2-Pentanone	U	U	330	U	U	U
Pyridine	U	U	200	U	U	U
O-Toluidine	U	U	2700	U	U	U

Table A-13 (Cont.) - Results of Semi-Volatile Organics Analyses

Water Table Aquifer

Parameter ug/l	W-24 MQA-745	MA-11D MQA-749
Acenaphthene	U	U
Benzoic Acid	U	U
Bis(2-chloroethyl)ether	3J	U
Bis(2-ethylhexyl)phthalate	-----	-----
2-Chlorophenol	U	U
4-Chloroaniline	160	U
1,2-Dichlorobenzene	2J	U
1,3-Dichlorobenzene	4J	U
1,4-Dichlorobenzene	U	U
2,4-Dichlorophenol	U	U
2,4-Dimethylphenol	U	U
2-Methylphenol	U	U
4-Methylphenol	-----	-----
2-Methylnaphthalene	U	U
Naphthalene	U	U
Phenol	U	U
Phosphorictriamide,Hexamethyl	U	U
1,2,4-Trichlorobenzene	U	U
Acetophenone	U	U
Aniline	U	U
2-Hexanone	U	U
4-Methyl-2-Pentanone	U	U
Pyridine	U	U
O-Toluidine	U	U

Shallow Artesian Zone

[illegible]

Table A-14 - Tentatively Identified Compounds Requiring Confirmation Using Authentic Standards

<u>Well #</u>	<u>Sample #</u>	<u>Compounds</u>	<u>Concentration, ug/l</u>
MA-3S	MQB-005	Tetrahydrofuran	800
		Cyclohexanone	400J
		Unknown BNA	10J
		Unknown BNA	20J
		Unknown BNA	10J
29	MQB-006	Thiobismethane	300J
		Unknown VOA	80J
		Ethylbenzene	70J
		Xylene	200J
		Xylene	70J
		Unknown BNA	80J
		C9H10 Substituted Benzene	100J
		2-chloroaniline	4700J
		1,3-Pentanediol, 2,2,4-Trimethyl	80J
		Unknown BNA	500J
		Unknown BNA	40J
		Unknown Chlorinated Compound	40J
		Benzene(Butoxymethyl)	50J
		X,Y-Dichloroaniline	100J
		Naphthalene, 1-methyl-	37J
		Unknown BNA	30J
		X,Y-Dichloroaniline	500J
		X,Y-Dichloroaniline	300J
		Unknown Chlorinated Compound	60J
		Phenol, 4-(1-methyl-1-phenylethyl-)	100J
		Sulfur Mol. (58)	2000J
MA-25	MQB-007	Cyclohexanol	60J
		Butyrolactone	8J
		Unknown	20J
S	MQB-008	Unknown BNA	100J
		Unknown BNA	20J
		Unknown BNA	10J
MA-9S	MQB-009	2-Propanol, 1-methoxy- (VOA)	5J
		Unknown BNA	80J
		Unknown BNA	20J
		HEMPA BNA	10J
AV-2	MQB-010	Unknown BNA	30J
W-29 (DUP)	MQB-011	Unknown BNA	60J

Table A-14 (Cont.) - Tentatively Identified Compounds Requiring Confirmation Using Authentic Standards

<u>Well #</u>	<u>Sample #</u>	<u>Compounds</u>	<u>Concentration, ug/l</u>
MA-2D	MQB-012	Benzene, ethyl	100J
		Xylene	200J
		Cyclohexanol	100J
		Xylene	100J
		Unknown	500J
		1,2,4-Trithiolane	2000J
		2-chloroaniline	20000J
		Unknown BNA	100J
		Unknown BNA	60J
		1,3,5-Trithiane	1000J
		Unknown BNA	600J
		Unknown BNA	1000J
		Unknown BNA	800J
		Unknown BNA	300J
		1,2,4,6-Tetrathiepane	600J
		Unknown BNA	300J
		Unknown BNA	100J
		Unknown BNA	400J
		Unknown BNA	400J
		Unknown BNA	200J
		Unknown BNA	90J
25	MQB-013	Cyclohexanol	100J
		Butyrolactone	10J
		Unknown BNA	10J
		Unknown BNA	10J
		2,5-Cyclohexadiene-1,4-dione,	
		2,6-bis(1,1-dimethylethyl)	20J
		Phenol, 2,4-bis(1,1-dimethylethyl)	10J
21A	MQB-014	Unknown BNA	40J
		Sulfur Mol. (S8)	400J
L-2	MQA-025	Unknown BNA	40J
		Unknown BNA	30J
		Unknown BNA	8J
MW-4A	MQA-736	Unknown BNA	30J
		Butyrolactone	10J
		Unknown BNA	10J
		Unknown BNA	20J
		2,5-Cyclohexadiene-1,4-dione,	
		2,6-bis	100J
		Unknown BNA	20J

Table A-14 (Cont.) - Tentatively Identified Compounds Requiring Confirmation Using Authentic Standards

<u>Well #</u>	<u>Sample #</u>	<u>Compounds</u>	<u>Concentration, ug/l</u>
W-29	MQA-739	Unknown BNA	70J
		Unknown BNA	20J
		Unknown BNA	100J
			9J
MA-1S	MQA-741	Methylmercaptan	4000J
		Xylene	400J
		Unknown BNA	500J
		Benzofuran	200J
		C9H10 Substituted Benzene	700J
		C9H10 Substituted Benzene	200J
		Benzenamine,2-chloro-	35720J
		X,Y-dichloroaniline	500J
		X,Y-dichloroaniline	3000J
		X,Y-dichloroaniline	1000J
		Unknown Chlorinated Compound	200J
		Unknown Chlorinated Compound	200J
		Unknown Chlorinated Compound	200J
		Tributyl Phosphate	200J
		Unknown BNA	200J
		Unknown BNA	300J
		Unknown BNA	300J
17	MQA-742	Dichlorodifluoroethane	10J
		Ethane,1,2-dichloro-1,1-difluoro	20J
		Unknown BNA	8J
		Trichloro-difluoro ethane	100J
		Cyclohexanol	60J
		2,5-Cyclohexadiene,1-4-Dione,6-Bis (1,1-dimethylethyl)-	30J
		Unknown BNA	10J
		Unknown BNA	20J
		Unknown BNA	40J
MW-4A (DUP)	MQA-743	Cyclohexanol	70J
		Unknown BNA	40J
		Unknown BNA	20J
		Unknown BNA	8J
		2,5-Cyclohexadiene-1,4Dione,2,6-bis (1,1-dimethylethyl)-	100J
		Unknown BNA	20J
		Unknown BNA	50J

Table A-14 (Cont.) - Tentatively Identified Compounds Requiring Confirmation Using Authentic Standards

<u>Well #</u>	<u>Sample #</u>	<u>Compounds</u>	<u>Concentration, ug/l</u>
MW-27	MQA-744	HEMPA	10J
		Unknown BNA	40J
W-24	MQA-745	Ethylether	30J
		Unknown VOA	20J
		Unknown BNA	30J
		Unknown BNA	40J
		2-chloroaniline	210J
		Unknown BNA	10J
		Unknown BNA	60J
		HEMPA	20J
		Unknown BNA	9J
MA-11D	MQA-749	Unknown BNA	80J
DP-2	MQB-004	Unknown BNA	70J
DP-1	MQB-026	Unknown BNA	40J
DP-5	MQA-750	HEMPA	20J
		Unknown BNA	60J

APPENDIX B

Evaluation of Quality Control Attendent
to the Analysis of Samples from the RES
Facility, New Jersey



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-142-

**EVALUATION OF QUALITY CONTROL ATTENDANT
TO THE ANALYSIS OF SAMPLES FROM
ROLLINS FACILITY, NEW JERSEY**

FINAL MEMORANDUM

Prepared for

**U.S. ENVIRONMENTAL PROTECTION AGENCY
Office of Waste Programs Enforcement
Washington, D.C. 20460**

Work Assignment No.	:	549
EPA Region	:	Headquarters
Site No.	:	N/A
Date Prepared	:	June 30, 1987
Contract No.	:	68-01-7037
PRC No.	:	015-0549-1003
Prepared By	:	PRC Environmental Management, Inc. (Ken Partymiller)
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**PRIVILEGED WORK PRODUCT PREPARED
IN ANTICIPATION OF LITIGATION**

**ENFORCEMENT
CONFIDENTIAL**

MEMORANDUM

DATE: June 30, 1987

SUBJECT: Evaluation of Quality Control Attendant to the Analysis of Samples
from the Rollins Environmental, New Jersey, Facility

FROM: Ken Partymiller, Chemist
PRC Environmental Management

THRU: Paul H. Friedman, Chemist*

TO: HWGWTF: Richard Steimle, HWGWTF*
Gareth Pearson (EPA 8231)*
Fred Haber, Region II
Brian Lewis, HWGWTF
Sam Ezekwo, Region II

This memo summarizes the evaluation of the quality control data generated by the Hazardous Waste Ground-Water Task Force (HWGWTF) contract analytical laboratories (1). This evaluation and subsequent conclusions pertain to the data from the Rollins Environmental, New Jersey sampling effort by the Hazardous Waste Ground-Water Task Force.

The objective of this evaluation is to give users of the analytical data a more precise understanding of the limitations of the data as well as their appropriate use. A second objective is to identify weaknesses in the data generation process for correction. This correction may act on future analyses at this or other sites.

The evaluation was carried out on information provided in the accompanying quality control reports (2-5) which contain raw data, statistically transformed data, and graphically transformed data.

The evaluation process consisted of three steps. Step one consisted of generation of a package which presents the results of quality control procedures, including the generation of data quality indicators, synopses of statistical indicators, and the results of technical qualifier inspections. A report on the results of the performance evaluation standards analyzed by the laboratory was also generated. Step two was an independent examination of the quality control package and the performance evaluation sample results by members of the Data Evaluation Committee. This was followed by a meeting (teleconference) of the Data Evaluation

* HWGWTF Data Evaluation Committee Member

Committee to discuss the foregoing data and data presentations. These discussions were to come to a consensus, if possible, concerning the appropriate use of the data within the context of the HWGWTF objectives. The discussions were also to detect and discuss specific or general inadequacies of the data and to determine if these are correctable or inherent in the analytical process.

Preface

The data user should review the pertinent materials contained in the accompanying reports (2-5). Questions generated in the interpretation of these data relative to sampling and analysis should be referred to Rich Steimle of the Hazardous Waste Ground-Water Task Force.

I. Site Overview

The Rollins Environmental facility is located in Bridgeport, New Jersey, and covers approximately 78 acres. It has been in operation since 1969. The facility has a landfill (now closed), a surface impoundment (closed), an incinerator (in operation), and RCRA lagoons which take scrubber wastes from the incinerator. These lagoons are suspected of leaking and are under a corrective action order. The facility landfill was excavated about 5 or 6 years ago to solidify the wastes and raise them above the water table by placing a sand bed under the wastes.

There is an upper (25-30 feet deep) aquifer, a middle (68-73 feet deep) semi-confined aquifer, and a large regional aquifer under the site. Both the upper and middle aquifer are being pumped and the water treated to remove contamination.

Twenty-five field samples (sample numbers preceded by an MQA or MQB) plus nine volatile sampling blanks (001, and 100 through 107) were collected at this facility. The samples included seven field blanks (001, 100, 102, 103, 105, 106, and 107), three equipment blanks (104, MQA738, and MQB001), a trip blank (MQB002), and two pairs of duplicate samples (well MW4A, samples MQA736/MQB736 and MQA743/MQB743 and well W-29, samples MQA739 and MQB011) as well as 18 other field samples. All samples were designated as low concentration ground-water samples. All samples were analyzed for all HWGWTF Phase 3 analytes with the exception of samples 001, and 100 through 107 which were only analyzed volatiles.

II. Evaluation of Quality Control Data and Analytical Data

1.0 Metals

1.1 Metals QC Evaluation

Total and dissolved metal spike recoveries were calculated for twenty-four metals spiked into two samples (MQB004 and 012). Nineteen total metal average spike recoveries from these samples were within the data quality objectives (DQOs) for this Program. The total barium, iron, magnesium, mercury, and thallium average spike recoveries were outside the DQO with values of 63, 134, 68, 50, and 74 percent, respectively. One of the total aluminum spike recoveries and one of the total iron spike recoveries were not calculated because the sample results were greater than four times the amount of spike added. Nine individual total metal spike recoveries were also outside DQO. This information is listed in Tables 3-1a and 3-2a of Reference 2 as well as in the following Sections.

Twenty-four dissolved metals were also spiked into two samples (MQB004 and 012). Twenty-two of the twenty-four dissolved metal average spike recoveries were

within the data quality objectives (DQOs) for this Program. Dissolved mercury and thallium average spike recoveries were outside DQO with values of 50 and 68 percent. Eight individual dissolved metal spike recoveries from these samples were also outside DQO. One each of the dissolved calcium, magnesium, and sodium spike recoveries were not calculated because the sample results were greater than four times the amount of spike added. This information is listed in Tables 3-1b and 3-2b of Reference 2 as well as in the following Sections.

The calculable average relative percent differences (RPDs) for all metallic analytes, with the exceptions of total aluminum and arsenic, were within Program DQOs. RPDs were not calculated for about two-thirds of the metal analytes because the concentrations of many of the metals in the field samples used for the RPD determination were less than the CRDL and thus were not required, or in some cases, not possible to be calculated.

Required metal analyte analyses were performed on all samples submitted to the laboratory.

No sample contamination involving the metallic analytes was reported in the laboratory or field blanks.

1.2 Furnace Metals

The quality control for the graphite furnace metals (antimony, arsenic, cadmium, lead, selenium, and thallium) was generally acceptable.

The total cadmium and lead and the dissolved arsenic, selenium, and thallium matrix spike recoveries for spiked sample MQB004 were outside DQO with values of 140, 162, 136, 145, and 68 percent, respectively. The total selenium, thallium, and lead and the dissolved arsenic, lead, and thallium matrix spike recoveries for spiked sample MQB012 were outside DQO with values of 63, 36, 71, 73, 47, and 68 percent, respectively. All results for these metals should be considered semi-quantitative at best except for the total and dissolved lead results which should be considered qualitative.

The correlation coefficients for the method of standard addition (MSA) analysis of total antimony in sample MQA744 and total cadmium in samples MQB008, 010, and 025 were below DQO. The correlation coefficients for the MSA analysis of dissolved arsenic in samples MQA739 and 741 were also below DQO. The total cadmium result for sample MQB010 and the dissolved arsenic result for sample MQA741 should be considered qualitative. All other results for the samples and analytes mentioned in this paragraph should not be used.

MSA analyses should have been performed on total cadmium in sample MQA775 and on dissolved lead in samples MQA773 and 783. Results for these metals in these samples should be considered semi-quantitative at best except for dissolved lead in sample MQA773 which should be considered qualitative.

The precision for the duplicate injection of dissolved selenium in sample MQB012 was above DQO. Dissolved selenium results for this sample should not be used. The analytical (laboratory) spike recovery for dissolved selenium in sample MQB006 was below DQO. Dissolved selenium results for this sample should be considered qualitative. The analytical spiked sample results for dissolved selenium in sample MQB012 were 32 percent above the calibration range. This had no effect on data usability as the dissolved selenium result for this sample was already judged unusable.

The duplicate RPD value for total arsenic in sample MQB012 was above DQO. Total arsenic results should be considered semi-quantitative.

A continuing calibration verification (CCV) and a continuing calibration blank (CCB) for cadmium were not analyzed after the analytical instrument was recalibrated. Both a CCV and a CCB should have been run on the recalibrated instrument.

CCVs were reported by the laboratory as failed in the analyses for total and dissolved arsenic and total lead. In some cases the laboratory failed to provide recalibration, CCV, CCB, and/or raw data. In other cases the CCVs were not within DQO limits. As a result, total arsenic results for samples MQA745, 749, 750, and MQB004; dissolved arsenic results for samples MQA749 and MQB004; and total lead results for samples MQB013 and 014 should be considered semi-quantitative, at best. Also, dissolved arsenic results for samples MQA741, 743 and MQB012 and total lead results for samples MQA736 and MQB009 should be considered qualitative.

Field duplicate results for dissolved cadmium in duplicate field sample pair MQA739/MQB011 and for total lead in pair MQA736/743 were excessive. The comparative precision of field duplicate results is not used in the evaluation of sample results. It is not possible to determine the source of this imprecision. The poor precision may be reflective of sample to sample variation rather than actual sampling variations. Therefore, field duplicate precision is reported for informational purposes only.

All dissolved antimony and cadmium results should be considered quantitative. Total antimony results should be considered quantitative with an exception listed below. All total and dissolved antimony and total arsenic results should be considered semi-quantitative. Dissolved arsenic, total cadmium, and total and dissolved selenium results, all with exceptions, should also be considered semi-quantitative. All total and dissolved lead results, dissolved arsenic results for samples MQA741, 743, and MQB012, total cadmium results for samples MQB008 and 025, and dissolved selenium results for sample MQB006 should be considered qualitative. Dissolved arsenic results for sample MQA739, total antimony results for sample MQA744, total cadmium results for samples MQB008 and 025, and dissolved selenium results for sample MQB012 should not be used. The usability of all graphite furnace analytes is summarized in Section 4.0 and 4.1 at the end of this Report.

1.3 ICP Metals

The matrix spike recoveries for dissolved copper and total barium and magnesium in sample MQB012 and total iron in sample MQB004 were outside DQO with recoveries of 74, 27, 46, and 134 percent, respectively. As a rule, high spike recoveries indicate a high bias in the data and low recoveries indicate a low bias. Dissolved copper and total iron results should be considered semi-quantitative. Total barium and magnesium results should be considered qualitative.

The low level (twice CRDL) linear range check for all dissolved beryllium, chromium, cobalt, nickel, silver, and vanadium results and certain of the results for total beryllium, chromium, cobalt, copper, nickel, silver, vanadium, and zinc exhibited low recoveries. Also, certain of the total manganese and all of the dissolved zinc results exhibited high recoveries. See Section B5 of Reference 3 for a detailed listing of analysis dates, samples affected, and biases. The low level linear range check is an analysis of a solution with elemental concentrations near

the detection limit. The range check analysis shows the accuracy which can be expected by the method for results near the detection limits. The accuracy reported for these metals is not unexpected.

The duplicate injection RPD for total aluminum in sample MQB012 was greater than DQO (8290 ug/L was reported in the initial analysis and 3980 ug/L in the duplicate analysis). Total aluminum results should be considered qualitative.

Sodium results for samples MQB012 and 013 exceeded the linear calibration range. These samples were diluted and rerun so there was no affect on the data usability.

Precision results for total and dissolved aluminum and total barium, beryllium, copper, iron, lead, magnesium, manganese, vanadium, and zinc in field duplicate sample pair MQA736/743 were excessive. The comparative precision of field duplicate results is not used in the usability evaluation of sample results. It is not possible to determine the source of this imprecision. The poor precision may be reflective of sample to sample variation rather than actual sampling variations. Therefore, field duplicate precision is reported for informational purposes only.

All total and dissolved beryllium, calcium, chromium, cobalt, manganese, nickel, potassium, silver, sodium, tin, vanadium, and zinc results should be considered quantitative. Dissolved aluminum, barium, iron, and magnesium and total copper results should also be considered quantitative. Total iron and dissolved copper results should be considered semi-quantitative. Total aluminum, barium, and magnesium results should be considered qualitative. The usability of all total and dissolved ICP metal analytes is summarized in Section 4.2 and 4.3 at the end of this Report.

1.4 Mercury

It was not possible to recover the total and dissolved mercury matrix spikes from sample MQB012 due to unknown salt interferences. The total and dissolved mercury results for samples MQB012, 013, 014, and 025 were affected and should not be used.

Precision results for total mercury in field duplicate sample pair MQA736/743 were excessive. The comparative precision of field duplicate results is not used in the usability evaluation of sample results. It is not possible to determine the source of this imprecision. The poor precision may be reflective of sample to sample variation rather than actual sampling variations. Therefore, field duplicate precision is reported for informational purposes only.

All mercury results should be considered semi-quantitative with the exceptions of both total and dissolved results for samples MQB012, 013, 014, and 025 which should not be used.

2.0 Inorganic and Indicator Analytes

2.1 Inorganic and Indicator Analyte QC Evaluation

The average spike recoveries of all of the inorganic and indicator analytes, except for cyanide, were within the accuracy DQOs. Accuracy DQOs have not been established for the bromide, fluoride, nitrite nitrogen, and sulfide matrix spikes.

Average RPDs for all inorganic and indicator analytes were within Program DQOs. The RPDs were not calculated if either one or both of the duplicate values were less than the CRDL. Precision DQOs have not been established for bromide, fluoride, nitrite nitrogen, and sulfide.

Requested analyses were performed on all samples for the inorganic and indicator analytes.

No laboratory blank contamination was reported for any inorganic or indicator analyte. TOX contamination was found in equipment blank MQB001 and field blank MQA738 at concentrations of 23 and 45 ug/L. The TOX CRDL is 5 ug/L.

2.2 Inorganic and Indicator Analyte Data

All results for sulfide, total phenols, TOC, and POX should be considered quantitative with an acceptable probability of false negatives.

High levels of sulfide in sample MQB012 appear to have interfered with the matrix spike recovery of cyanide from this sample. Therefore, cyanide results for samples MQB001, 007, and 012, which had high levels of sulfide, should not be used. All other cyanide results should be considered qualitative.

The spike recoveries for nitrate nitrogen from sample MQB012 and for sulfate from sample MQB004 were outside DQO with recoveries of 115 and 70 percent. All results for these analytes should be considered semi-quantitative. Between the second and third CCVs of the first of the ion chromatography (bromide, chloride, fluoride, sulfate, and nitrate and nitrite nitrogen) analytical batches, an excessive number of samples were run. Therefore, all ion chromatography results for samples MQA738, 745, 750, and MQB004 should be considered semi-quantitative. The holding times for the nitrate and nitrite nitrogen analyses ranged from 4 to 13 days from receipt of the samples which is longer than the recommended 48 hour holding time for unpreserved samples. All nitrate and nitrite nitrogen results should be considered semi-quantitative. Precision results for chloride, fluoride, and sulfate in field duplicate sample pair MQA736/743 were excessive. The comparative precision of field duplicate results is not used in the usability evaluation of sample results. It is not possible to determine the source of this imprecision. The poor precision may be reflective of sample to sample variation rather than actual sampling variations. Therefore, field duplicate precision is reported for informational purposes only. In summary, bromide, chloride, and fluoride results, with exceptions, should be considered quantitative. All nitrate and nitrite nitrogen and sulfate results and bromide, chloride, and fluoride results for samples MQA738, 745, 750, and MQB004 should be considered semi-quantitative.

Precision results for TOC in field duplicate sample pair MQA736/743 were excessive. The comparative precision of field duplicate results is not used in the usability evaluation of sample results. It is not possible to determine the source of this imprecision. The poor precision may be reflective of sample to sample variation rather than actual sampling variations. Therefore, field duplicate precision is reported for informational purposes only. All TOC results should be considered quantitative.

Calibration verification standards for POC were not analyzed. A POC spike solution was run during the analytical batch but the "true" value of the spike was not provided by the laboratory. EPA needs to supply the inorganic laboratory with a POC calibration verification solution. Until then, the instrument calibration can not be assessed. The POC holding time ranged from 4 to 13 days. Although the

EMSL/Las Vegas data reviewers recommend a seven day holding time, the laboratory has been instructed by the EPA Sample Management Office that a 14 day holding time is acceptable. Precision results for POC in field duplicate sample pair MQA739/MQB011 were excessive. The comparative precision of field duplicate results is not used in the usability evaluation of sample results. It is not possible to determine the source of this imprecision. The poor precision may be reflective of sample to sample variation rather than actual sampling variations. Therefore, field duplicate precision is reported for informational purposes only. The POC results should be considered qualitative.

The TOX matrix spike recovery from sample MQB012 was high with a value of 128 percent. Due to this all TOX results should be considered semi-quantitative at best. TOX contamination was found in equipment blank MQB001 and field blank MQA738 at concentrations of 23 and 45 ug/L. The TOX CRDL is 5 ug/L. As a HWGWTF convention, all positive TOX results five times the higher concentration or less should not be used, all TOX results between five and ten times the higher of the concentrations should be considered qualitative, and all results ten times the level of contamination or greater, as well as all negative results, should be considered quantitative (semi-quantitative in this case due to poor spike recovery). Therefore, TOX results for samples MQA738, 741, 742, MQA001, 006, and 012 should be considered semi-quantitative, TOX results for samples MQA745 and 750 should be considered qualitative, and all other TOX results should not be used. Additionally, high chloride concentrations in samples MQA744, 745, MQB012, 013, 014, and 025 may have enhanced the TOX concentration measured in those samples. The TOX holding time ranged from 3 to 13 days. Although the EMSL/Las Vegas data reviewers recommend a seven day holding time, the laboratory has been instructed by the EPA Sample Management Office that a 14 day holding time is acceptable.

Precision results for POX in field duplicate sample pair MQA739/MQA011 were excessive. The comparative precision of field duplicate results is not used in the usability evaluation of sample results. It is not possible to determine the source of this imprecision. The poor precision may be reflective of sample to sample variation rather than actual sampling variations. Therefore, field duplicate precision is reported for informational purposes only. All POX results should be considered quantitative.

Samples were analyzed for both carbonate and bicarbonate. The analytical protocols for these analytes require 24 hour holding times which are nearly unobtainable using the EPA contract laboratory program (CLP) shipping methods. Alkalinity results for these samples should be considered qualitative while the carbonate and bicarbonate results should not be used due to the excessive holding times. The HWGWTF is reevaluating the holding time requirement.

3.0 Organics and Pesticides

3.1 Organic QC Evaluation

All matrix spike average recoveries were within established Program DQOs for accuracy. Individual matrix spike recoveries which were outside the accuracy DQO will be discussed in the appropriate Sections below.

All surrogate spike average recoveries, with the exception of the herbicide surrogates which were not required or analyzed, were within DQOs for accuracy. Individual surrogate spike recoveries which were outside the accuracy DQO will be discussed in the appropriate Sections below.

All reported matrix spike/matrix spike duplicate average RPDs were within Program DQOs for precision. Individual matrix spike RPDs which were outside the precision DQO will be discussed in the appropriate Sections below.

All average surrogate spike RPDs were within DQOs for precision. No surrogate standard was used or required for the herbicide analysis.

Requested analyses were performed on all samples submitted to the laboratory.

Laboratory (method) and sampling blank contamination was reported for organics and is discussed in Reference 4 as well as the appropriate Sections below.

Detection limits for the organic fractions are summarized in Reference 4 as well as the appropriate Sections below.

Organic sample identification numbers MQA025 (well L-2), 026 (well DP-1), MQB736 (well MW4A), and 743 (well MW4A, duplicate) correspond to inorganic and dioxin sample numbers MQB025, 026, MQA736, and 743. In this report the sample numbers used for the inorganics and dioxins will be used throughout and all organic sample numbers will be corrected to the inorganic and dioxin numbers.

3.2 Volatiles

The analytical laboratory exceeded the volatile holding time of seven days for all of the volatile samples. Holding times ranged from 3 to 42 days in excess of the seven day holding time. Negative volatile results for all samples should be considered unreliable because of this. Positive volatile results should be considered qualitative.

Acetone contamination was found in sampling blanks 001, 100, 101, 102, 103, 104, 105, 106, 107, MQA738, MQB001, and 002 at concentrations ranging from 1 to 106 ug/L. Additionally, acetone contamination was found in laboratory (method) blanks MB-5 through MB-8 at concentrations of 1 to 3 ug/L. The acetone CRDL is 10 ug/L. The source of this contamination is not known. All positive acetone results should not be used due to this blank contamination.

Methylene chloride contamination was found in sampling blanks 103, 104, MQA738, MQB001, and 002 at concentrations ranging from 1 to 5 ug/L. Additionally, laboratory (method) blanks MB-1 through MB-4 and MB-6 through MB-9 contained methylene chloride contamination. This common laboratory contaminant was present at concentrations of 1 to 3 ug/L. The methylene chloride CRDL is 5 ug/L. The source of this contamination is not known. All positive methylene chloride results, except those for sample MQB006, should not be used due to this blank contamination.

Trichlorofluoromethane was found in sampling blank MQA738 at a concentration of 1 ug/L and 1-methoxy-2-propanol was found in sampling blank 001 at a concentration of 6 ug/L. These results have no impact on data quality as these compounds were not found in any field samples.

Estimated method detection limits were CRDL for all samples except MQA741, MQA005, and 012 which were 100, 20, and 33 times CRDL, respectively. Dilution of these samples was required due to the high concentration of organics. The volatile compound negative results, with exceptions listed below, should be considered unreliable due to excessive holding times. All positive methylene chloride results, except for sample MQB006, and all positive acetone results should not be used due

to laboratory (method) blank contamination. The probability of false negative results is unknown due to the lengthy holding times of the samples. The positive volatile results are probably not an artifact of the lengthy holding times and thus probability of false positives is acceptable and the positive volatile results should be considered qualitative and biased low.

3.3 Semivolatiles

Initial and continuing calibrations, tuning and mass calibrations, matrix spikes and matrix spike duplicates, surrogate spikes, and chromatograms were acceptable for the semivolatiles.

The analytical laboratory exceeded the semivolatile 40 day holding time between extraction and analysis for all but two (MQB005 and 008) of the samples. Holding times ranged from 5 to 25 days in excess of the permitted 40 day holding time between extraction and analysis. Semivolatile results for these samples should be considered semi-quantitative at best.

The acid surrogate spike recoveries for phenol-D5, 2-fluorophenol, and 2,4,6-tribromophenol from samples MQA778 and 778RE (its reanalysis) ranged from no recovery to 4 percent recovery. These results are outside DQO. The acid fraction results for sample MQA778 should be considered unreliable.

Two of the semivolatile laboratory (method) blanks, MB-2 and MB-4, contained bis(2-ethylhexyl)phthalate contamination at concentrations of 3 and 4 ug/L. The bis(2-ethylhexyl)phthalate CRDL is 10 ug/L. No positive bis(2-ethylhexyl)phthalate results should be used. Cyclohexanol, 4-methylphenol, and a trichloro-1-propene contamination was also detected in MB-2 at concentrations of 9, 11, and 8 ug/L. 4-Methylphenol results for sample MQB012 should not be used due to this contamination.

The organic analytical laboratory failed to perform an adequate number of semivolatile method blank analyses.

The terphenyl-D14 (in sample MQA741), 2-fluorobiphenyl (in sample MQB004), and phenol-D5 (in sample MQA736) surrogates were out of DQO. This caused no impact on data usability.

Samples MQA741 and MQB012 were diluted by a factor of 10 prior to analysis. Due to a dilution factor of 2.0 for all other samples, the estimated detection limits for the semivolatiles were approximately twice the CRDL.

The semivolatile data are acceptable and the results should be considered semi-quantitative for all samples with exceptions. Results for samples MQB005 and 006, with the exception of the bis(2-ethylhexyl)phthalate results, should be considered quantitative. All positive bis(2-ethylhexyl)phthalate results and 4-methylphenol results for sample MQB012 should not be used due to laboratory blank contamination.

3.4 Pesticides

The analytical laboratory exceeded the pesticide 40 day holding time between extraction and analysis for all but two (MQB002 and 014) of the samples. Holding times ranged from 3 to 9 days in excess of the permitted 40 day holding time between extraction and analysis.

Dieldrin was detected in sample MQA739 at a concentration of 0.117 ug/L but was not reported in that sample by the laboratory.

Dieldrin and kepone were reported in sample MQB012. These may be false positives as the peaks specified by the laboratory to be representative of dieldrin and kepone had retention times slightly outside the laboratory established retention time windows.

A large injection peak was present in the laboratory (method) blank chromatograms. This peak may have interfered with the detection of alpha- and beta-BHC.

Many pesticides in the internal standards and evaluation mixes were outside the retention time windows established by the laboratory.

The dibutylchlorodate retention time shift was outside DQO for 45 standards and samples.

Sample MQA741 was diluted by a factor of 10 and thus the detection limit for the pesticide fraction in this sample is 10 times the CRDL. The estimated method detection limits for all other pesticides analyses is the CRDL. The pesticides results should be considered qualitative with the exceptions of samples MQA739, 741, and MQB012 which should be considered unreliable.

3.5 Herbicides

The herbicides for which the laboratory analyzed include only 2,4-D, 2,4,5-T, 2,4,5-TP, chlorobenzilate, phorate, disulfoton, parathion, and famphur.

No surrogates were included for the chloro- or phospho-herbicide results.

The quality of the chloro-herbicides chromatograms was not sufficient to allow the tentative identification and confirmation of these compounds. Several field samples were reported to contain chloro-herbicides. However, numerous chloro-herbicide peaks were observed in the method, field, and trip blank chromatograms. The tentative identification and quantification of chloro-herbicides in all samples should be considered unreliable due to this blank contamination.

The detection (DB5) and confirmation (DB1) columns used by the laboratory for the phospho-herbicide analyses were too similar to allow adequate confirmation. Because of this all positive phospho-herbicide results (only disulfoton and parathion results reported for sample MQA741) should be considered unreliable. Negative phospho-herbicide results should be considered qualitative.

The laboratory failed to use the 3-point external standard calibration method for all herbicides. A one point method was used.

Method 8150 is not adequate for the determination of chlorobenzilate. Chlorobenzilate could be more accurately determined by using the pesticide method. Chloro-herbicide standard chromatograms were specified by the laboratory to be representative of the four chloro-herbicides for which the laboratory analyzed. However, five peaks were observed in the chromatograms. The fifth peak may have arisen from the derivatization of chlorobenzilate. There is the possibility that both the methyl and ethyl esters of chlorobenzilate are formed when using Method 615.

The negative phospho-herbicide results should be considered qualitative due to the lack of surrogates. The positive phospho-herbicide results should be considered unreliable due to the lack of surrogates and inadequate confirmational column analysis. The chloro-herbicide results should be considered unreliable due to blank contamination and the absence of surrogate analyses. The estimated method detection limits were the CRDL for the herbicides.

3.6 Dioxins and Dibenzofurans

Dioxin and dibenzofuran spike recovery from the two native spiked samples ranged from 88 to 136 percent which is considered to be acceptable accuracy. One of these samples was inadvertently spiked twice. No performance evaluation standard was required or evaluated for dioxins and dibenzofurans. The target analytes were detected in the duplicate field samples for monitoring well 4A so precision (RPD) information was available for these samples. Target analytes were not detected in the laboratory duplicate samples so laboratory precision could not be evaluated. Required dioxin/dibenzofuran analyses were performed on all samples submitted to the laboratory. No dioxin or dibenzofuran contamination was found in the laboratory (method) or field blanks. Diphenylether interference (at m/z ratio 410) was observed in the PeCDF window for sample MQQA736.

Due to a method modification supplied to the laboratory by the US EPA Sample Management Office, the column performance check solution was not analyzed by the laboratory.

The recovery of the internal standard for carbon-13 labeled 2,3,7,8-TCDD from one of the standards was above DQO.

The resolution between carbon-13 labeled 1,2,3,4-TCDD in the recovery standard and 2,3,7,8-TCDD in the internal standard was above DQO.

Samples MQA736, 739, 742, MQB003, 004, 006, 012, 025, and method blank CC#120767 did not meet the DQO requirement for resolution of the percent valley being less than or equal to 25 percent. The results for these samples should be considered semi-quantitative at best.

The dioxin and dibenzofuran results should be considered to be semi-quantitative. The probability of false negative results is acceptable. OCDD, TCDF, PeCDF, HxCDF, HpCDF, and OCDF were detected in the duplicate field samples collected from well 4A.

III. Data Usability Summary

4.0 Graphite Furnace Metals, Total

Quantitative: antimony results with exceptions
Semi-quantitative: all arsenic and thallium results; cadmium and selenium results with exceptions
Qualitative: all lead results; cadmium results for sample MQB010
Unusable: antimony results for sample MQA744; cadmium results for samples MQB008 and 025

4.1 Graphite Furnace Metals, Dissolved

Quantitative: all antimony and cadmium results
Semi-quantitative: all thallium results; arsenic and selenium results with exceptions
Qualitative: all lead results; arsenic results for samples MQA741, 743, and MQB012; selenium results for sample MQB006
Unusable: arsenic results for sample MQA739; selenium results for sample MQB012

4.2 ICP Metals, Total

Quantitative: all beryllium, calcium, chromium, cobalt, copper, manganese, nickel, potassium, silver, sodium, tin, vanadium, and zinc results
Semi-quantitative: all iron results
Qualitative: all aluminum, barium, and magnesium results

4.3 ICP Metals, Dissolved

Quantitative: all aluminum, barium, beryllium, calcium, chromium, cobalt, iron, magnesium, manganese, nickel, potassium, silver, sodium, tin, vanadium, and zinc results
Semi-quantitative: all copper results

4.4 Mercury

Semi-quantitative: mercury results with exceptions
Unusable: total and dissolved mercury results for samples MQB012, 013, 014, and 025.

4.5 Inorganic and Indicator Analytes

Quantitative: all sulfide, total phenols, TOC, and POX results; bromide, chloride, and fluoride results with exceptions
Semi-quantitative: all nitrate and nitrite nitrogen and sulfate results; bromide, chloride, and fluoride results for samples MQA738, 745, 750, and MQB004; TOX results for samples MQA738, 741, 742, MQB001, 006, and 012
Qualitative: all POC and alkalinity results; cyanide results with exceptions; TOX results for samples MQA745 and 750

Unusable: TOX results with exceptions; cyanide results for samples MQB001, 007, and 012; all carbonate and bicarbonate results

4.6 Organics

Quantitative: semivolatile results for samples MQB005 and 006 with exceptions listed below

Semi-quantitative: semivolatile results with exceptions

Qualitative: positive volatile results; pesticide results with exceptions; phospho-herbicide results with exceptions

Unreliable: negative volatile results with exceptions; pesticide results for sample MQA739, 741, and MQB012; all chloro-herbicide results; disulfoton and parathion (phospho-herbicides)

Unusable: all positive methylene chloride (a volatile) results, except for sample MQB006; all positive acetone (a volatile) results; 4-methylphenol (a semivolatile) results for sample MQB012; all positive bis(2-ethylhexyl)phthalate (a semivolatile) results

4.7 Dioxins and Dibenzofurans

Semi-quantitative: all dioxin and dibenzofuran results

IV. References

1. Organic Analyses: EMSI
2421 West Hillcrest Drive
Newbury Park, CA 91320
(805) 388-5700

Inorganic and Indicator Analyses:
Centec Laboratories
P.O. Box 956
2160 Industrial Drive
Salem, VA 24153
(703) 387-3995

Dioxin/Dibenzofuran Analyses:
CompuChem Laboratories, Inc.
P.O. Box 12652
3308 Chapel Hill/Nelson Highway
Research Triangle Park, NC 27709
(919) 549-8263

2. Draft Quality Control Data Evaluation Report (Assessment of the Usability of the Data Generated) for Case G-2363HQ, Site 49, Rollins, NJ, 5/26/87, Prepared by Lockheed Engineering and Management Services Company, Inc., for the US EPA Hazardous Waste Ground-Water Task Force.
3. Draft Inorganic Data Usability Audit Report, for Case G-2363HQ, Rollins Environmental, NJ, Prepared by Laboratory Performance Monitoring Group, Lockheed Engineering and Management Services Co., Las Vegas, Nevada, for US EPA, EMSL/Las Vegas, 5/27/1987.
4. Draft Organic Data Usability Audit Report, for Case G-2363HQ, Rollins, NJ, Prepared by Laboratory Performance Monitoring Group, Lockheed Engineering and Management Services Co., Las Vegas, Nevada, for US EPA, EMSL/Las Vegas, 5/27/1987.
5. Draft PCDD/PCDF (Dioxin/Dibenzofuran) Usability Audit Report, for Case G-2363HQ, Rollins Environmental, NJ, Prepared by Laboratory Performance Monitoring Group, Lockheed Engineering and Management Services Co., Las Vegas, Nevada, for US EPA, EMSL/Las Vegas, 5/21/1987.

APPENDIX C

Inventory of Hazardous Waste On-Site During Task Force Evaluation

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ROLLINS ENVIRONMENTAL SERVICES (NJ). INC.
GHDP INVENTORY
BY L-NUMBER

L#	WASTE CODE	ROW	QTY	LAB NUMBER	MANIFEST	TOTAL POUNDS REC	QTY BTU REC	TRTMENT	COMMENTS
10014		12	2						
10019	I	12	1	3719	NJA0204254	5000	10	9300	E 502
10069	T		5	0222	NJA0209687	1865	5	13900	V
10076		14	6	3915	NJA0193942	20000	46	2000	E
10130	I		7	0157	PAB2919921	3280	11	15900	V
10147			1	0078	NJA0250837	13950	21	6400	E/R/
10197			8						
4146	T	11	2	1883	NJA0168571	630	1	2000	R/K
4571	N	5	1	7783	N/A	180	1	2000	V
5110		8	1						
5110		9	1						
5122		9	1						
5122		11	3						
5122		14	1						
5152	N	5	1	N/A	N/A	N/A	1	2000	R/K
5256		11	1						
5359		11	1						
5381		14	1						
5415		2	1						
5552	T	5	1	3755	NJA0238068	5222	14	16900	V
5609	I	10	1						
5667		16	1	N/A	N/A	N/A	N/A	11700	R/K
5706		11	1						
5752		11	2						
6215	T	15	2	276	NAJO178352	32497	72	15100	R/K
6216	T	17	3	3621	NJA0239354	1225	29	3000	R/K
6271		13	8						
6300	I	12	1	429	NJA0134499	16980	77	11785	R/K
6321	I	8	1	3097	NJA0167158	412	1	9300	V
6321		17	4						
6323		5	1						
6366	T	10	5	6721	NJA0166850	1834	64	2000	V
6402		18	1						
6480		14	3						
6480		17	1						
6551	P	8	1	294	NJA0121825	7041	11	6500	V
6610	I	7	1	499	MJA0084128	10692	23	15700	V
6610		8	1						
6674		13	1						
6715		9	1						
6769	N	2	2	4157	N/A	1200	4	23000	R/K
6769		5	1						
6769		8	1						
6769		14	3						
6769		17	2						
6821	T	1	1	3786	NJA0180220	548	1	4700	V

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ROLLINS ENVIRONMENTAL SERVICES (NJ), INC.
GHDP INVENTORY
BY L. NUMBER

L#	WASTE CODE	ROW	QTY	LAB NUMBER	MANIFEST	TOTAL POUNDS REC	QTY REC	BTU	TRTMENT	COMMENTS
6823	I	1	2	3787	NJA0180220	716	2	17900	V	
6861		8	1	0292	NJA0201841	4215	20	7900	R/L	FLIPPER
6899	I	5	1		NJA0003155	3165	8	13000	V	
6899		8	1							
6933		11	1							
6972	X	12	2	2277	NY1231947	4400	15	5600	V/R	
6973	I	10	1							
6973		11	1							
7010		15	2							
7010		17	1							
7143		3	1	3294	NJA0223132	13224	29	12500	V	
7170		3	1							
7185	T		1	0150	NJA0077072	202	1	8200	V	
7330	T	17	1	5372	NJA0065766	2700	6	13900	V	
7372		11	1							
7387		11	2							
7428		13	1							
7483		16	1							
7484		16	1							
7484		16	1							
7487	T	2	1	3457	NJA0205931	530	2	10700	R/K	
7489		12	2							
7492	I	15	2	3458	NJA0205931	530	1	9900	V	
7497	N	7	2	3891	N/A	7680	24	N/A	R/K	
7506	I	3	1							
7506		5	1							
7519		6	1							
7555		7	1							
7566		12	1	1216	NJA0183964	800	2	13600	V	
7570		11	1							
7571		3	2							
7571		4	4							
7571		10	11							
7571		10	1							
7577		8	1							
7594	I		5	0216	NJA0151709	1600	5	19700	V	
7596	I	7	1	2255	NJ0230511	482	1	19000	V/R	
7607		5	1	1330	NJA0183349	3014	121	N/A	K/E	LABPACL
7612	C	6	1	0027	NJA0036663	400	1	N/A	HOLD	FOR RES (LA)
7612		12	1							
7621		9	1							
7632	N	2	1	0046	N/A	500		21400	R/K	
7640		13	2							
7650		15	1							
7656	I	13	1	6576	NJA0122201	2400	6	2000	R	
7656		16	2							

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ROLLINS ENVIRONMENTAL SERVICES (NJ), INC.
GHDP INVENTORY
BY L NUMBER

L#	WASTE CODE	ROW	QTY	LAB NUMBER	MANIFEST	TOTAL POUNDS REC	QTY REC	BTU	TRTMENT	COMMENTS
---	---	---	---	---	---	---	---	---	---	---
7657		9	1							
7658		12	1							
7658		15	1							
7662	I		26	0259	NJA0260251	2600	26	VISUA	KILN	FLIPPER
7666	N	8	1	3871	N/A	N/A	50	16000	R/K	
7669	I	3	2	3423	NJA0234903	1800	18	2000	R/K	
7671	I		5	0260	NJA0260251	600	5	8900	R	20GAL/D
7679		8	24	0299	NJA0260252	2200	22	15500	R/K	
7685		4	2							
7685		16	1							
7686	N		5	0262	NJA0260251	2500	5	11500	V	
7703	I	15	1	3904	NJA0022984	9000	20	2000	V	
7703		18	1							
7726	N	5	1	4447	N/A	3252	12	11700	R/K	
7733	N	7	1	0879	N/A	3088	8	19700	R/K	
7738		3	1							
7742	T	5	1	3429	NJA0025941	6420	14	18400	R/K	
7765	I	15	1	1336	PAA6344903	3120	6	6000	V/R	
7770		11	1							
7775	I	8	1	796	NJO146347	18940	N/A	5700	R/K	T1754
7811	H	2	1	5382	NJA0065766	450	1	2000	R/K	
7816	P	5	1							
7818		3	3							
7838	I	8	2							
7838		11	1							
7838		17	1							
7855	N	10	1	2448	NJA0127538	N/A	45	K	R/K	
7866	I	5	1	6541	NJA0029659	390	1	15600	R/K	
7866		11	2							
7866		13	1							
7867		13	1							
7868		8	1							
7868		13	2							
7869	I	2	1	1502	NJA0151007	500	1	13700	R/K	
7869		3	1							
7869		5	1							
7872	C	9	1	5608	NAJ0057393	3325	95	12400	R/K	
7872		9	1							
7872		11	1							
7896		2	1							
7926	T	11	1	3597	NJA0204754	10000	20	2000	R/K	
7953		3	1							
7954	T	17	1	1756	NJO203890	1500	3	2000	R/K	
7956		17	1							
7967	C	3	1	1887	NJA0168571	11090	29	12100	R/K	
7967		12	1							

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ROLLINS ENVIRONMENTAL SERVICES (NJ), INC.
GHDP INVENTORY
BY L NUMBER

L#	WASTE CODE	ROW	QTY	LAB NUMBER	MANIFEST	TOTAL POUNDS REC	QTY REC	BTU	TRTMENT	COMMENTS
8374	N	9	1							
8391	T	2	1	3523	NJA0051826	1770	10	16079	V	
8391		3	1							
8404	I	2	1							
8404		5	1							
8404		8	4							
8423	I	15	1	3458	NJA0040409	1433	3	9500	R/K	
8425	I	15	1	3457	NJA0040409	344	1	14800	R/K	
8427	N	15	1	3460	NJA0040409	240		14500	R/K	
8428	I	17	3							
8429	I	10	1	3464	NJA0040409	840	2	14400	R/K	
8429		12	1							
8430	I	9	1							
8432	N	7	2							
8432		10	1							
8436	I	12	1	3452	NJA0040409	40	1	13900	R/K	
8438	N	12	2	3462	NJA0040409	362	1	20200	R/K	
8440		10	1							
8442		10	3							
8442		17	4							
8443	N	15	1	3463	NJA0040409	4839	13	25600	V	
8444	I	7	1							
8449	I	2	1	108	NJA0062873	100	2	3700		
8450	N	3	1	5273	NJA0038530	N/A		3600	V	
8455		13	1							
8455		16	2							
8455		16	2							
8456	C	3	666	3678	NJA0055206	36650	62	6500	V	
8456		3	1							
8456		7	1							
8456		15	5							
8456		15	4							
8456		16	2							
8456		18	1							
8480		17	1	7533	NJA0127481	19056	78		K	
8485	I	13	1							
8548	I	2	1	4336	NJA0055207	1625	3	18000	V	
8548		17	2							
8549	I	3	1	4334	NJA0055207	5417	10	19800	V	
8549		11	1							
8550	I	13	1	4335	NJA0055207	12458	23	12900	R	
8550		14	8							
8550		16	1							
8566	I	17	1	6550	NJA0057877	1920	8	2000	V	
8576		8	4							
8576		16	1							

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ROLLINS ENVIRONMENTAL SERVICES (NJ). INC.
GHDP INVENTORY
BY L NUMBER

L#	WASTE CODE	ROW	QTY	LAB NUMBER	MANIFEST	TOTAL POUNDS REC	QTY REC	BTU	TRTMENT	COMMENTS
---	---	---	---	---	---	---	---	---	---	---
8584	N	13	2	5881	N/A	900	2	8000	R/K	
8590		8	1							
8623	C	13	1							
8623		16	5							
8627	N	16	1	0374	NJA0178069	1920		10800	R/K	
8636	N	16	1	4367	NJA0061387	3300	9	17400	V	
8636		18	1							
8639	I	1	1	6432	NJA0185120	3800	17	9700	R/K	
8639		18	1							
8640		11	4							
8640		17	2							
8641		12	3	5807	N/A	N/A	N/A	12000	R/K	
8641		15	1							
8641		15	1							
8641		16	1							
8644		8	1							
8644		8	1							
8651		13	2							
8656	T	17	1							
8657	T	16	2							
8657		17	1							
8661	P	17	1							
8675		9	2							
8677	N	5	1	6380		1302	3	13300	R/K	
8690		5	2							
8690		13	1							
8690		17	1							
8691		10	4							
8700	P	8	1	7726	NJA0119677	200	2	1890	V	
8704	I	5	1							
8705			2	0300	NJA0181281	750	2	16400	V	
8716	X	15	1	N/A	N/A	N/A	N/A	2000	R/K	
8717		18	1	6065	NJA0065753	900	2	2000	R/K	
8732	I	5	1	4931	NJA0053582	16410	N/A	9400	R/K	T/THEEL
8756		16	1							
8791	T	2	1	N/A	N/A	N/A	N/A	N/A	R/K	INTERPL
8825		16	1							
8891	I	3	2	3425	NJA0234903	4780	2	16200	V	CARCI
8898		13	1							
8903	T	3	1	7454	NJA0163101	1150	25	13800	R/K	
8903		5	1							
8903		7	5							
8903		9	4							
8922		9	1							
8934	I	10	1	6405	NJA0090131	8060	54	7500	K	1/HR
8954	I	7	1	3090	NJA0240422	1000	2	2000	V	

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ROLLINS ENVIRONMENTAL SERVICES (NJ), INC.
GHDP INVENTORY
BY L NUMBER

L#	WASTE CODE	ROW	QTY	LAB NUMBER	MANIFEST	TOTAL POUNDS REC	QTY REC	BTU	TRTMENT	COMMENTS
8965	T	9	1	6799	NJA0002815	36720	80	11900	V	
8971		7	1							
9047		9	1							
9091	T	16	1							
9117	T	2	1	312	NJA0164212	400	1	2000	V	
9151	I	7	2	1732	CTA0076505	16660	31	9400	R/K	
9189		7	1							
9242	I	16	1							
9242		16	1							
9243		5	1	0023	NJA0120152	350		18800	R/K	
9249	T	16	8							
9249		16	8							
9287	N	2	1	2487			14	8200	R/K	
9288	N	6	2	4046	NJA0173872	1200	2	10000	R/K	
9311	C	13	2	1327	NJA0161536	4000	9	12400	R/K	
9311		18	5							
9352	I	3	1	0738	NJA007226	1000		14000	V	
9409	I	2	1	3469	NJA0238865	4128	12	10000	R/K	
9409		7	3							
9409		11	4							
9442		7	2	0302	NJA0169281	200	1	18500	R/K	
9456	I	11	1	1217	NJA0183964	400	1	17400	V	
9475		7	1	2807	N/A	13720	28	13200	R/K	
9485	I	15	2	0946	NJA0127517	300	2	20000	R/K	
9486	I	15	8	951	NJA0127517	11120	18	8600	R/K	
9486		16	3							
9521	N	18	1	1929		4190	10	10500	V	
9533	T	7	1	2345	NJA0049829	438	1	5000	R/K	
9556	I	12	1	3217	NJA0121040	250	1	10000	V	
9590	X	2	1	1721	NJA012754	4500	18	16000	R/K	
9607	I	2	1	1649	NJA0178035	800	2	7000	K	
9608	I	8	1	1648	NJA0161536	1034	4	11900	K	
9612	I	12	1	1862	NJA0036369	2060		2000	V	
9627	T	12	1	1773	NJA0190912	15333	19	1280	R	
9627		13	5							
9627		18	1							
9640	N	4	3	2476	N/A	N/A		7200	R/K	
9642	N	6	4	4049	NJA0173872	4000	23	8800	R/K	
9642		9	7							
9741	T	12	1	2962	NJA0100417	2000	4	2600	V	> SO2
9742	T	2	1	2963	NJA0100417	1000	2	13000	E	
9746	N	5	1	3858	NJA0121805	1380	2	9000	V	
9750	I	14	2	3839	NJA0143240	20590	46	11400	V	
9797	I	6	4	4047	NJA0173872	3030	5	6100	R/K	
9797		9	1							
9812		18	1							

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ROLLINS ENVIRONMENTAL SERVICES (NJ), INC.
GHDP INVENTORY
BY L NUMBER

L#	WASTE CODE	ROW	QTY	LAB NUMBER	MANIFEST	TOTAL POUNDS REC	QTY REC	BTU	TRTMENT	COMMENTS
9845	T	7	1	2813	NJA0005220	25		N/A	EDUC	SO2 WL
9893	X	3	1	3484	NJA0101080	1956	4	12300	V	
9893		18	2							
9929	I	18	2	3500	NJA0220879	1020	3	20600	V	
9973	I	18	2	3340	NJA0200155	N/A	33	16800	R/K	LABCO
B2358		16	3							
H2O		7	1							
H2O/FM		13	2							
J100		17	1							
NJDEP		12	4							
NJDEP		16	1							
NJDEP		17	10							
TAC42		5	1							
UN500		16	2							
UNK		8	1							
UNK17		13	1							
UNK2		9	1							
UNK46		11	1							
UNK46		15	1							
UNK5		12	1							
UNK55		15	1							
UNK6		11	1							
UNK6		13	1							
UNK8		8	1							
UNK8		11	1							
UNK99		18	1							
W H2O		8	1							
WADE		12	3							
WADE		13	1							
WADE		14	11							
WADE		15	2							
WADE		18	1							
** Total ***										

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ROLLINS ENVIRONMENTAL SERVICES (NJ), INC.
DRUM PAD INVENTORY
BY L NUMBER

L#	WASTE CODE	TYPE DRUM	ROW	LAB NUMBER	MANIFEST	TOTAL POUND REC.	QTY REC	BTU	TRTMENT	COMMENTS
9181			4							
9181			4							
9181			6							
9183	P		6	2351	NJA0127433	15760	158	2000	K	
9189		FIBER	5							
9258			1							
9287			4							
9311			1							
9350			6							
9537	T		6	2438	NJA0049829	428	1	2000	V	
9554			5							
9598			1							
9658	N		5	1942	N/A	180	1	2000	K	
9687	T		1	3442	NJA0121801	4000	8	11000	R/K	
9823	I	FIBER	5	3730	NJA0132228	653	5	2000	R/K	
9823		FIBER	5							
9852			4							
9889			4							
HELPA		FIBER	6							
SLUDG		FIBER	5							
UNK18			4							
UNK27			5							

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ROLLINS ENVIRONMENTAL SERVICES (NJ). INC.
DRUM PAD INVENTORY
BY L NUMBER

L#	WASTE CODE	TYPE DRUM	ROW	LAB NUMBER	MANIFEST	TOTAL POUND REC.	QTY REC	BTU	TRTMENT	COMMENTS
8028		FIBER	3							
8121			2							
8127			6							
8182			2		INNERPLANT		1	14400	K	
8182			2							
8278			6							
8302				N/A	N/A	N/A	N/A	N/A	R/K	INTERPL
8310			1							
8337			7							
8339			5							
8339			6							
8339			7							
8347			1							
8372			2							
8402			5							
8420			2							
8420			4							
8444			6							
8456			4	3678	NJA0055206	36650	62	6500	V	
8480			1							
8480			6							
8500			2							
8584			2	5881		9500	2	8000	R/K	
8640			4	6037	INNER PLAN	ALL	ALL	21000	K	
8663			2							
8677			6							
8716			4	6065	NJA0065753	900	2	1500	R/K	
8718			5	4972	NJA0014438	13160	8	9500	R/K	
8728		FIBER	3							
8741			7							
8743			2							
8769			6							
8778			6							
8791			2	2445	NJA0166224	4200	14	2000	R/K	
8890			2	3903	NJA0202846	16251	221	N/A	K/E	LABPACK
8890			6							
8903			6							
8905			4							
8938			6							
8969										
9023			5	1168	NJA0180187	1908	4	16800	K	
9048			4							
9085		FIBER	1							
9085		FIBER	3							
9121			6	2308	NJA0164228	400	1	2000	R/K	
9135	C			0224	NJA0239774	N/A	15	11800	R/K	

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ROLLINS ENVIRONMENTAL SERVICES (NJ), INC.
DRUM PAD INVENTORY
BY L NUMBER

L#	WASTE CODE	TYPE DRUM	ROW	LAB NUMBER	MANIFEST	TOTAL POUND REC.	QTY REC	BTU	TRTMENT	COMMENTS
10026	T		2	3759	NJA0140803	530	1	11200	V	
10053	P	FIBER	5	3731	NJA0132228	68	1	2000	K	
10076			2	3915	NJA0193942	20200	46	2000	E	
10076			5							
10114		STEEL								
4047		FIBER	3	0288	NJA0201885	20240	88	4000	KILN	
4149				0052	NJA023888	14980	33	10700	R/K	3DR/HR
4493		FIBER	3	0201	N/A	572	4	4400	K	
4619			6	3962	NJA0193475	5346	33	13900	K	
5250	X		5	3977	NJA0127025	1350	13	16600	V	
5252			2							
5608			2							
5799			2							
6097		FIBER	3	3974	NJA0193415	3078	14	10400	K	
6215			5	3620	NJA0239354	15572	23	11100	R/K	
6215			6							
6216			6	3621	NJA0239354	1225	29	3000	R/K	
6321			4	0067	NJA0137746	N/A	1	7800	V	
6500		FIBER	1							
6618			1							
6769			6	1558		2000	4	1700	R/K	
6850	I		6	3960	NJA013475	738	4	2000	V	
6899			2							
7178			4							
7386			4							
7389			5							
7455			5							
7539		FIBER	3							
7577			4							
7587	T	FIBER	3	3728	NJA0132228	346	1	4700	V	
7588		FIBER	5	1749	NJA0132227	1202	5	13700	K	
7588		FIBER	5							
7628			5							
7659			6	1958	NJA0212307	1800	9	9200	K	
7685			1	3871	N/A	N/A	18	2000	V	
7703			7	3394	NJA0223132	12312	27	15400	V	ACRYLONIT R
7706		FIBER	1							
7706		FIBER	3							
7725			6	7637		2000	8	4600	K	
7803	C	PAISLS	5	1750	NJA0132227	239	5	14800	R/K	
7867			6	3782	NJA0182456	13055	40	11100	R/K	LABCOVERA G
7869	I		2	2062	NJA0151007	274	1	13700	R/K	
7886			2	1698	NJA0183976	23140	2	62000	V	
7985			2							

3. EQUIPMENT — Complete the following table for each piece of equipment involved in the use, manufacture, storage, handling, or generation of the EHS as described in Section E2. Equipment should include all storage and process vessels. Use the codes indicated on the bottom of Page 2 where necessary.

EQUIPMENT		DISTANCE TO NEAREST PROPERTY LINE (Ft.)	EQUIPMENT SIZE				AGE OF EQUIPMENT (Yrs.)	EXISTING AIR POLLUTION CONTROL DEVICE	PERMIT OR CERTIFICATE NO.	COMMENTS
DESCRIPTION	DESIGNATION		Capacity	Average	Maximum	Units				
1. Storage Tank	Receiving T301	280	7000			GAL	8	Pipe Away Con- servation Vent	68328	
2. Storage Tank	Receiving T302	295	7000			GAL	8	Pipe Away Con- servation Vent	68328	
3. Storage Tank	Blow T303	250	20000			GAL	8	Pipe Away Con- servation Vent	68328	
4. Storage Tank	Blow T304	280	20000			GAL	8	Pipe Away Con- servation Vent	68328	
5. Storage Tank	T308	370	30000			GAL	1	Pipe Away Con- servation Vent	68328	
6. Storage Tank	Thinning T310	390	20000			GAL	7	Pipe Away Con- servation Vent	68328	
7. Tank Trailer	P301/302	280	NA	240		GPM	3	NA	NA	
8. Unloading Pump	P307/308	280	NA	50		GPM	3	NA	NA	
9. Incinerator										
10. Feed Pump										
11. Storage Tank	T323	810	150,000			GAL	2	Carbon Absorp- tion Unit	68328	
12. Tank Pump	P362	810	NA			GPM	7	NA	NA	

11. Storage Tank T311 30,000

12. Storage Tank T103 Thinning

All above designated as Solvent (except 310, 311, and T103)

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TANK FARM PUMP/GAUGE SHEET

DAY ENDING 2300: 2-15

TANK NUMBER	GALLONS/PERCENT	CONTENTS	2300 Gal.	0700 Gal.	1500 Gal.	2300 Gal.
T-301	60	1 FINE TR		78	4680	78
T-302	60	BLEND TA		64	12800	31
T-303	200	"		50	10000	52
T-304	200	STORAGE		23	7200	40
T-308	300	THERMALOX		50	10000	32
T-310	200	STORAGE		20	6000	20
T-311	300	THERMALOX		71	12780	71
T-103	180	STORAGE			44200	123
T-323	1500	LIO. NITROGEN		125		59
ISP-301	Chart					59

• THERMALOX - CONTAMINATED WATER
- PAILED SURDAGE

OPERATOR	START	END	TIME	FROM	OPENING GAL.	CLOSING GAL.	TO	OPENING GAL.	CLOSING GAL.
DB	DB	0215	0305	11763	4687	MT	T-303	61	12200
DB	DB	0345	0435	11760	4556	MT	T-304	27	5400
DB	DB	0600	0700	115239	5250	MT	T-310	22	4400
DB	DB	09:20	10:25	11762	3526	MT	T-308	23	7200
J.M.	J.M.	11615	11655	111752	4057	MT	T-304	53	10600
J.S.	J.S.	1800	1830	115242	1412	MT	T-304	73	14400
J.S.	J.S.	122:05	0000	T-311	20	6000	T-303	0	MT

Signature

